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Some New Machine Tools.

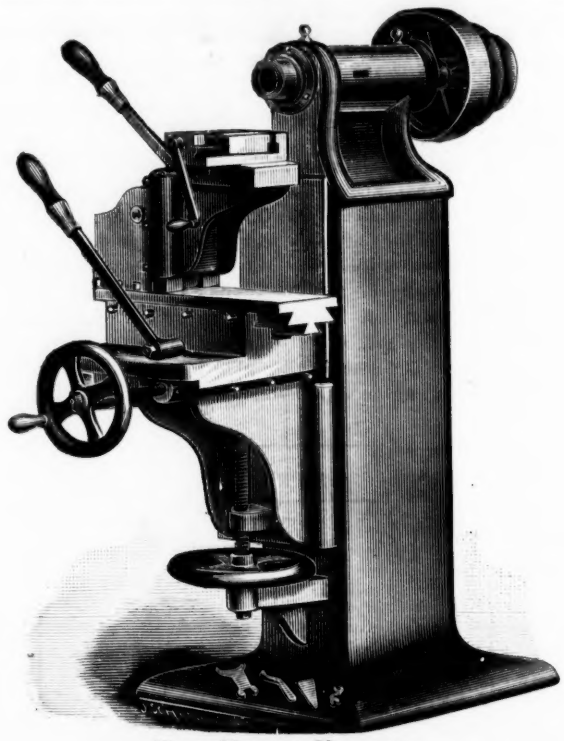
The large milling machine represented by an engraving on this page is of the ordinary Lincoln pattern, differing but little, except in size, from those built by a number of firms. The clutch which drives the feed screw is inside of the carriage, and always covered by the table, so that no dirt can get into it to interfere with its working. It is operated by a lever on the front side of the carriage; as the lever is raised, it carries up with it a hardened steel plunger that slides in a groove planed inside of carriage to receive it. The top of the plunger is cut at an acute angle, so that a dog, secured in the slot on the side of the table, in passing along will ride upon it and force it down, thus opening the clutch.

The support for the end of the arbor is very heavy, and stiffened by two parallel bars 2″ in diameter running through it, and bolted firmly to the head stock. Set screws with brass ends are provided, so that the support can be clamped firmly at any point. The screws that hold down the spindle are 1¼″ in diameter. The cap on the head stock is in one piece, being attached at both ends, adds much to the strength of the head. The worm that drives the feed screw runs in an oil well, so that it is constantly supplied with that much-needed article. The feed is very powerfully back geared in addition to the worm and worm wheel. The machine is driven by a 4″ belt, the cone having three teps. The spindle is provided with anti-friction curves at both ends, and a loose sleeve on the rear end admits of adjustment for wear. The center of the arbor can be raised 14″ above the face of the working table, which is 4 ft. 8″ long, and 10″ wide on top, and 12½″ wide on bottom or bearing surface, and has a bearing in carriage of 23½″. The bed or body of machine is 5 ft. 6½″ long, 10″ deep, and 20″ wide, made very heavy. The distance between the head and the tail stock is 36″. The weight of machine complete with countershaft is about 4,200 pounds.

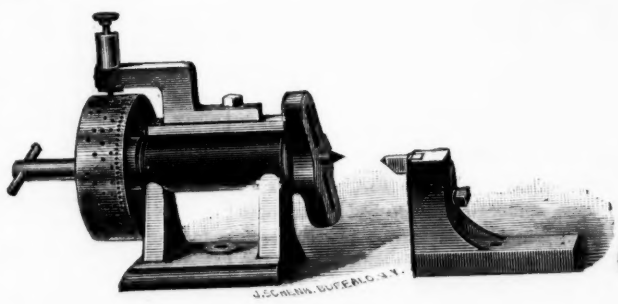
This machine is constructed for regular milling work, and is believed to be the largest of its kind regularly built in this country.

The engraving of the hand milling machine, shown herewith, needs but little explanation, as its movements can be understood at a glance. It is designed for light work, where speed in handling is the prime object.

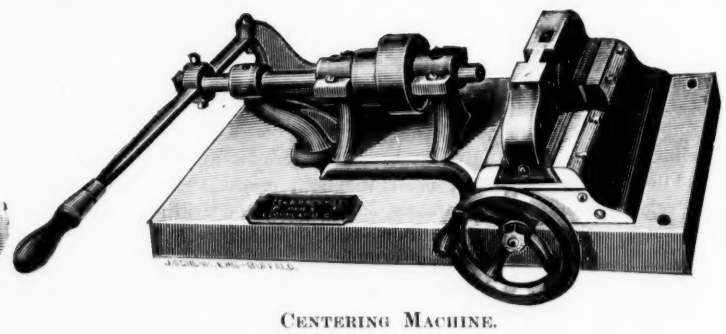
The vice is of peculiar construction, having a circular dovetailed base that is gripped by jaws on the knee. It can be turned around in any position, and instantly held there firmly. The knee is raised by rack and pinion, and the platen is also moved in the same manner, a motion of 4″ being obtained by one stroke of the lever. The adjustment in and out from face of column is 6″. Besides the up and down movement of the smaller knee by the lever, there is an adjustment of the main knee by screw and hand wheel, to enable the operator to bring the work to the proper height, so that lever motion can be used to the best advantage. In this machine the cone was put on the outer end of spindle so as not to interfere with work of a peculiar shape. Manufacturers usually put a head on their machines similar to a lathe head, with end bearings and the cone between. This machine is very well adapted to light quick work.



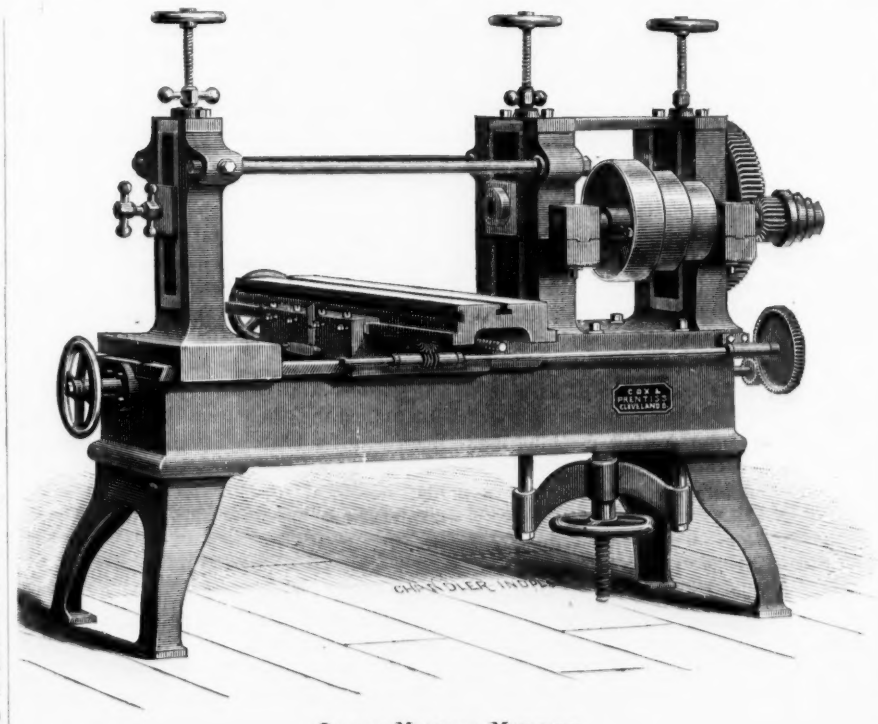
HAND MILLING MACHINE.



INDEX CENTERS.



CENTERING MACHINE.



LARGE MILLING MACHINE.

The centering machine, shown by one engraving on this page, is placed on a very substantial base, and can be set on a bench or any other convenient place. The jaws are of tempered steel, and bolted firmly in place, and further secured by steel dowel pins. They are operated by right and left square threaded screws, which move positively and hold the work very firmly. The spindle is made of best machinery steel, and accurately fitted. It is operated by a lever, nicely adjusted to give it a smooth forward motion. Two sizes of these machines are made, one will hold work from 2″ down to nothing; and the other from 3″ downwards.

The manufacturers of these machines inform us that they never allow more than $\frac{1}{32}$″ of stock on their work for turning, and the machines work so accurately that they find this more than sufficient.

The index centers for milling machines or planers, also shown by one of the cuts on this page, are very substantially made and designed for every day work. They will swing a piece of work 10 inches in diameter in the clear. The screw center in the head is made of tempered tool steel, and runs in a steel nut accurately turned and exactly central with the spindle, on which the index wheel is placed. The wheel is 6½ inches in diameter, and accurately drilled to suit all numbers up to 18, and nearly all even numbers up to 80. The arm that carries the index finger is made very strong to avoid all vibration, and is in one piece, sliding in a groove placed on the top of the body or head. This is believed to be a much better plan than that ordinarily used of slotting the arm and sliding the finger in the slot, and tightening by means of a nut on the finger. The back center is made adjustable up and and down for cutting tapered work, and is made as low as possible to allow the cutter or tool to come down close to the center for small work. The cutters have a long bearing surface.

These machines and attachments are made by Cox & Prentiss, Cleveland, O.

Elasticity.

BY F. F. HEMENWAY.

The genuine universal machinist possesses one quality, that is expressed by the term elasticity. This quality helps to fit him to a good many places, that he wouldn't fit without it. The elastic machinist don't have his places and his jobs fitted to him. He fits himself to them. A good many machine jobs get stretched, because the man who handles them can't stretch himself. It don't pay to get the elasticity from the job. It ought to be furnished by the operator. I wish it could be demonstrated just how much education had to do with the matter of elasticity. I don't particularly refer to the education gained from schools and col-

leges. I don't object to such education. On the contrary, I appreciate it; but such an education alone don't make its possessor elastic. It sometimes makes him bigoted and inelastic. I mean the education a man gets, by keeping abreast of current events and ideas bearing on his profession, by reading, by study, and by observation. It does the machinist a world of good who has devised certain plans and modes, by the use of which he has accomplished good results, to find that some one has met with equal success, by ways and means quite different. If an operative machinist has never turned anything larger than a 20″ pulley, the quality of elasticity will get him right down to doing a good job on a 20-foot pulley, without much delay. He won't find himself stretched up to the point instantly; in fact, he won't find himself stretched up to the point at all; but the quality of the elasticity will permit him to stretch himself there, without danger of breaking in the operation. You can't graduate an elastic machinist from the best shop in the world. He can graduate himself—entitled to a diploma from Sackett's shop, or from Wycoff's—I'm not sure; but he would do it the easiest from Wycoff's; but he can do it from either. Education won't do it, but he can't do it without education. He can't be educated up to it, but he can educate himself up—or down to it. It pays the machinist to possess this quality. That sort of men are always wanted. Jones wants him, Smith wants him, and he is wanted in Maine and California at the same time. He isn't the kind that you wedge into a shop. He is of the kind that make the shop. You wedge in the kind that won't fit in only one place. There isn't any particular call for the machinist who only fits one place. There is a sort of standing invitation for him to travel around till he finds an opening of his size, and there is policy for him in filling that opening, till he gets crowded out by circumstances. Such men don't control circumstances; they are controlled by circumstances. A machinist ought to fit himself to control circumstances. It is in every way better and more satisfactory than being controlled. * * * *

When Spliner starts his little shop with one man, he wants an elastic machinist. He wants a man that can get his ideas around to work on a steam engine, and a corn husker in the same day, and do a fair job on both. His man must appreciate the difference between a crank pin turning 500 times a minute under a pressure of 700 pounds to the square inch, and a lazy shaft turning 8 times an hour under a pressure of 15 pounds.

He can get men enough who are all right on the steam engine—that is on some particular piece of it, and he can find men to get on with the husker. He will be at some pains and expect to pay better wages to the man who is at home on both. When his little shop expands into a condition of half a dozen journeymen you may see him looking for the same sort. He has got used to them and he hankers after them. When his shop blossoms out into 400 or 500 men he will have the same hankerings, and he will get all he can of this kind, but he will have to wedge in with the other sort. The supply won't equal the demand. He will make a permanent fixture of his elastic men, and the others will constitute the floating population. He can afford to pay his elastic men better wages because it don't cost anything to organize them, and it don't cost anything to keep them organized. It costs money and time to organize the others, and some day when the belt runs off his organizing machine there is chaos. The elastic machinist has the air of manly independence in the way he holds up his head when he applies for work. He don't ask for a job at squaring up nuts or watching a planer. He asks for a job of machine work and takes it as it comes. When Jones' mill jobs are all worked up, he applies to Smith for a machine job on sewing machines.

It is a good thing to know how to do something in a certain way. It is a better thing to know how and why to do it so. The why leads up to knowing how and why to do something else. After all there is a good deal in any certain way or process besides the way or process itself. I have known men to whom the calculus was a rudiment and logarithms a thing of memory, fail to make any reasonable calculations in steam engineering. I have known others, whose mathematical attainments were concluded in the four fundamental rules of arithmetic, manage by stretching their means to arrive at correct conclusions.

* * * * Opposed to this idea of elasticity, in a special sense, is that of conservatism. I don't hardly believe it is opposed to it—not real genuine conservatism. While the machinist plies his vocation for hire, he don't want to know much of this quality. When he runs his own shop he will find it advisable to study the subject to some extent. I don't mean that conservatism that makes a man shut up shop because some particular product he has been supplying has gone out of market. He needs to bring his elasticity into play then. I mean that part of the quality which puts a check on his thinking he can do all things better than any one else; that part of the quality which keeps the machine-shop proprietor to the business for which his talents and surroundings are best adapted. A great deal of good business has been ruined by trying to cover too much ground. The desire to spread out in too many directions sometimes gets the best of the careful proprietor. There is a good deal of difference between a steam engine and an engine lathe. The operative machinist need only consider that both represent good boring and turning, and planing and drilling. The proprietor must appreciate that different consideration must be given to the manufacture of each. I have known elaborate establishments—you couldn't call them shops—started to manufacture everything, from the largest marine engine to the smallest steam gauge. I don't know them any more. It takes about all the talent usually concentrated in one establishment to keep ahead of the times in marine engine building. If you mix that talent up through a hundred products, it is too much diluted. Reasonably well gotten-up establishments don't find any difficulty in employing all their energy in manufacturing boiler and engine attachments. It has come to the requiring of a good deal of talent to successfully manufacture any one line of the standard machine products of the day. There is more of steam engines, or steam pumps, or machine tools, or steam attachments, than one man will be able to find out. The public are not buying their steam engines from sewing machine manufacturers, nor their steam gauges from water wheel manufacturers, so much as they were. * * * *

I am inclined to get back to the educational part of the subject. I can't evolve philosophy enough to get behind Mac's statement of the case. Mac employs 25 machinists in a strictly manufacturing business and in a country village. Their mail all comes through the office. He says the men he tries to keep get reading matter through the mail. He wants a man to run his planer who knows a good many things because some one else knows them; and he wants men to manufacture machinery for him who wouldn't be on the town if he shut up shop. When his big lathesman goes fishing the man who runs his small shaper takes his place, and sometimes both are utilized in fitting. I suspect he employs elastic machinists. I suspect their reading, with the study it induces, makes them elastic. I know they are better workmen, better citizens, and make more money for the possession of that quality.

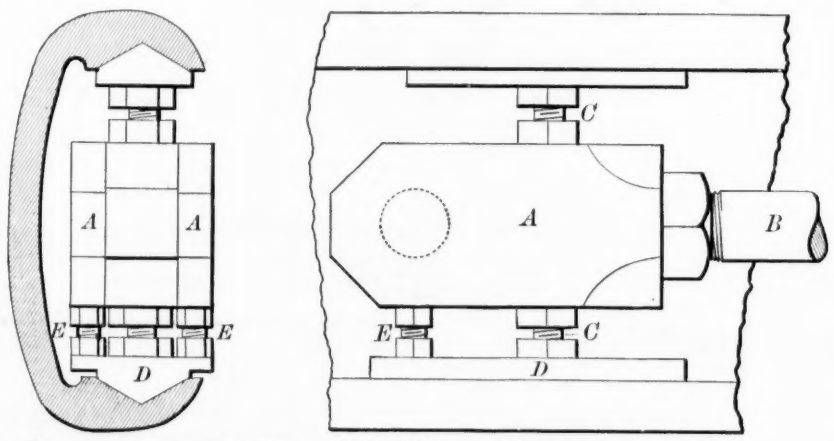
* * * * If there is a machinist in this broad land who takes and reads a couple of live mechanical papers, and who has expended ten dollars a year for the past ten years for books, and don't find it pecuniarily a good investment, I want to hear from him.

Alteration to the Cross Head of a Corliss Engine.

By CHAS. E. EMERY, Ph. D.

A PAPER READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

It will be remembered by the gentlemen present, in reference to engines with side frames, carrying guides (usually of "V" shape) above and below the piston rod, as introduced years ago by Mr. Allen, of the Novelty Iron Works, New York, and made popular by Mr. Corliss in his engines, that the customary form of cross head is, in general terms, a spade handle, shown by *A* in the accompanying engraving. It is provided at one end with a fixed pin for receiving one end of the connecting rod, and at the other with threads to receive the piston rod *B*, the connection to each slide, or gib, being through a single large set-screw *C*, arranged vertically in the body of the cross head, behind the pin, and at some distance therefrom, so as to give ample room for the removal of the connecting-rod strap and brasses. That is: the vertical thrust of the connecting rod is not carried through the sides to the guides, directly under and above the cross-head pin, as it should be, but at a point so far behind the cross-head pin as to practically make the cross head and piston rod a lever, with the set-screws as a fulcrum, operating to lift the piston up and down in the cylinder, and produce unequal wear, and frequently noise when the engine is heavily loaded.



ALTERATION TO CROSS HEAD OF CORLISS ENGINE.

The cause of the ill-working of pistons in Corliss engines in some cases was not generally understood, and gave rise to many changes of detail in the piston itself. Some suggestions were made by those who had ascertained the true causes of the difficulty, but it was not till a comparatively recent period that Mr. Corliss changed the form of his cross head for his larger engines, to bring the bearing of the slides directly under the pin.

The writer recently had occasion to put in a second-hand Corliss engine, with a cylinder 16 inches in diameter and 42 inches stroke of piston, which had a cross head of the kind first above referred to, and considered the defect of sufficient importance to warrant the change in the construction of the lower gib *D*, also shown in the engraving.

As will be seen, the bottom gib is simply extended towards the crank, some little distance beyond the center of the cross-head pin, and small set screws placed either side, under the jaws of the spade handle to transfer the vertical thrust directly to side ears on the gib. The rear set screw and jam nut are made with notched cylindrical edges, so that they may be adjusted with a set or chisel.

Other details will be readily understood from the drawing.

The arrangement operates well.

Of course, the additional length of gib runs off the end of the guide, which is no objection, and in fact is utilized by placing there a small box, with pad, to lubricate the gib each time it reaches the end of the stroke.

DISCUSSION.

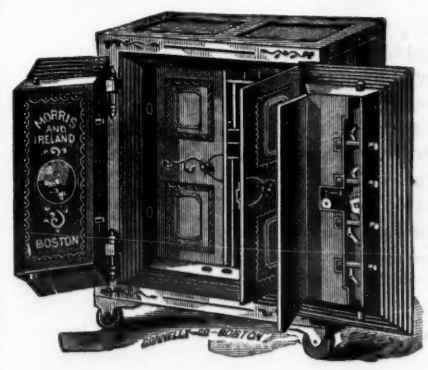
MR. LEAVITT.—Mr. President, I would like to say a word on this subject. I think Mr. Emery has made an improvement on Mr. Corliss' process. This cross head is a very serious thing, and has caused many very serious accidents. At the mills at Lowell the piston rod broke square at that nut (indicating), and smashed up the engine. The fracture was almost perfectly smooth, as though the surfaces had been rubbed together. The rod was five inches in diameter.

MR. STRONG.—I would like to ask the gentleman if the action upward on the outward thrust, would not be the same as it is downward?

MR. EMERY.—The gentleman probably will recollect that the strain on the guides is always one way, so long as the engine is run in the same direction. In this case, during one stroke, the rod pulls at an angle, and causes pressure on bottom guide, and during the return stroke pushes at another angle, so as to cause pressure on the same guide.

MR. STRONG.—That may be in the case where the fly-wheels never carry the load. But in the case of rolling-mill engines, where the fly-wheel carries the load—generally more than the piston does while the work is being done—would not the action then be the other way?

MR. EMERY.—There would be some action, but the rigidity of the parts would probably take it up. It would, probably, be better to put set screws on both, but on a light-running engine, if it will work at all without something of that kind, this will entirely overcome the difficulty in the direction in which the main part of the load acts. It was a mere make-shift that I thought I would call attention to here, as it is so simply fixed without reconstructing anything except the gib.



An Eight Flange Fire-Proof Safe.

In the safe here shown, the bolts and locks are placed on the inside of the door, and as the filling is between the locks and bolts and the outside plate of the door, the safe can usually be unlocked, according to the combination, even after a severe fire, rendering it unnecessary to break in. The safe is iron-lined instead of wood-lined, permitting the use of a greater amount of water in the filling, without danger of the safe becoming damp.

The eight flanges in this safe not only provide eight laps to prevent the passage of heat; but on account of the long distance, the heat is obliged to pass over these flanges. Each of the corners of the safe is secured with angle iron, which tends to prevent injury from falling, or falling walls or timbers. The makers are Morris & Ireland, Boston, Mass.

Experiments with Non-Conductors of Heat.

By Chas. E. Emery, Ph. D.

MEMORANDUM PRESENTED TO THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

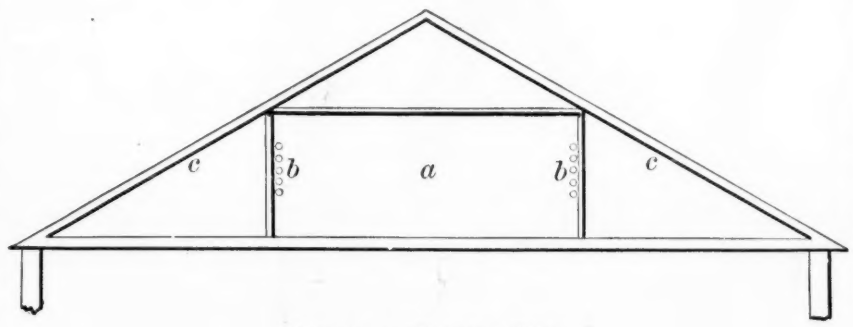
Stenographically reported for the American Machinist.

I was called on about a year ago to investigate the subject of supplying steam through underground pipes, in connection with a district system in New York City. I found that steam had actually been conducted to points a mile from the boiler. I did not find that there was very much accurate information as to the economy of the system. It was practicable to a degree: that was certain. They were carrying steam as far as they sometimes carry gas, and people were comfortably warm. They were carrying power to considerable distances also. It became necessary, however, before going into it on the scale which would be required in a large city like New York, to thoroughly investigate each one of the different principles involved in construction, the flow of steam in pipes, but particularly this question of non-conducting materials; those which were non-combustible being of prior importance. For this purpose an apparatus was constructed on a much larger scale than anything I know of having been done before, which has given us some very excellent results. A boiler, something like four feet in diameter and twelve feet long, was made with three ten inch tubes, with their ends open externally. Into these tubes were placed smaller tubes to receive steam, and around the inner tubes were placed the non-conducting materials; water being circulated through the larger shell outside of the outer tubes. The results were shown by the amount of steam condensed in the inner tube—the water of condensation being conducted to small cylindrical vessels, each provided with a glass gauge.

The line of pipe for supplying steam to these internal tubes was drained at various points; and, finally, the steam was admitted to a drum below the level, and the pipes that led to the interior of the tubes were carried vertically up at one end, and at the other end other pipes carried down to the smaller vessels. The whole apparatus was swathed very thickly with felt—three sides of the glass gauge were covered permanently with felt, and a felt covering provided over the remaining side, and a person in observing just turned up a little corner and looked in, so that the effect of the different non-conducting materials placed in the pipe was accurately determined, as the small condensations outside, due to the temperature of the air would not materially affect the results.

The first series of experiments were made with tubes of different sizes and varying thicknesses of material, to find the effect of the different thicknesses of a constant material, wool or felt, or whatever it might be. The results of those experiments I cannot give now; I have not had time to write out the paper, and, besides, it developed an apparent contradiction which we have to meet in our experiments sometimes. The fact was that the smaller tubes condensed more per square foot of surface than the larger ones, although they had more non-conducting material around them. That was true of wood as a non-conducting material. The reason of that becomes evident when we consider the radial lines on which the heat is transmitted from the pipe to the absorbent about it. The loss due to the increase of external surface, increased faster than the gain due to additional thickness. A little mathematical calculation will, probably, bring all the experiments to the same basis; and at this time I will only attempt to show the general result of the other series of experiments in which the size of pipes were kept constant, and the thickness of the non-conducting material kept constant, and, therefore, the test was simply to determine the values of different kinds of non-conducting materials. That, in brief, will give us something that is very interesting. Hair felt was the best non-conducting material, I think, of all those tested, and is given at 1 (maximum). The value of 2″ of mineral wool, No. 2, as a non-conductor was $83\frac{3}{100}$ per cent. of hair felt; 2″ of No. 2 mineral wool and tar was 0.715. In regard to mineral wool, I will say that it will sink in water readily; it absorbs moisture rapidly, and, when wet, soon becomes reduced to a powder; and to protect it—make it water proof—it is found desirable to cover the pipe with tar which has sufficient volatile matter in it to penetrate the wool, and then it becomes waterproof so that it does not absorb moisture; but that affects its non conducting properties to some extent. Two inches of sawdust, 68 per cent.; 2″ No. 1 mineral wool, 67.6 per cent.; charcoal, 63.2 per cent.; 2″ pine wood across the grain, 55.3 per cent.; 2″ loam, 55 per cent.—that is from the Jersey flats; that loam over there is almost all vegetable fiber, it has not yet become compact; slacked lime, from the gas works, expressed decimally, with hair felt as unity, 0.48; coal ashes, 0.345; coke only, .277 (we use that as fuel); 2″ of air space, 0.136—that dashes a great many people's hopes, and is as interesting as any part of it; 2″ of asbestos, 0.363; 2″ of western coke, about the same as the other coke; 2″ of gas house charcoal, 0.47; the other charcoal being 0.63.

Now, these are very interesting, particularly so this matter of an air space. It is supposed when you put an air space around a pipe, that it is about as good as anything we can have. The fact is, convection or circulation takes place; the air is cooled on one side of the space, descends and rises on the other, and it is necessary to break up the air spaces, and that undoubtedly accounts for the efficiency of these different materials. It is the air, probably, that is the non-conductor; but it should be kept quiescent instead of being allowed to circulate. The air space itself is of very little value, until the circulation is prevented.



Section of Factory Roof.

DISCUSSION.

Mr. Durfee—I would like to ask Mr. Emery if he has ever tried any experiments with an envelope constructed anything in this way: with an air space, and then a surrounding envelope of hair, felt, or other material.

Mr. Emery—Yes, sir; that was tried inside of wooden logs, and it was not as efficient as to fill it all up with wood. I could not give the whole list. I have simply taken what I had in my pocket for reference. I thought it would interest the gentlemen present. It would take quite an elaborate paper to go through all that we have been over. The variations in the results need to be discussed mathematically, or else they look contradictory. These being all on the same basis, can be presented for comparison.

Col. Fuller—Mr. President, I desire to inquire if the conditions under which the water entered the cylinder were such that each of the tubes had an equal chance—if the temperature of the water was preserved equally round them all?

Mr. Emery—Yes, sir; and at first I made some changes in the position of the tubes—tried them over again to settle that very point; and for a long time the felt was kept in one of them, and the other two were filled with other materials. But the water was taken from the Croton, and there was such a small quantity of steam condensed that the difference between the initial and final temperatures was only two or three degrees, so that it was impossible for a result to be very different in any two cases. Besides, I changed them about without noticing any material difference between the experiments. The results given are not from single experiments, but averages of a large number.

Mr. Durfee—I have never had any opportunity to make any extended experiments in the matter of covering pipes. But on one occasion I had to have covered quite a long length of 14-inch pipe, and it was covered in this way. There were some rings about an inch and a half thick put at intervals around the pipe. Involving those rings was wire cloth, and outside of that an inch and a half of hair felt. That again was enclosed in a thin covering of rubber cloth. I do not know what the value of that would be relative to any others, but it was very effective in the particular case I applied it to. On one occasion during a very severe winter, when the thermometer was thirty degrees below zero outside of the buildings, I noticed an icicle two feet long hanging on the underside of this covering.

Mr. Woodbury—In the way of solving this same problem of protecting steam pipes from radiation, about ten years ago I had occasion to make some investigations on this point; and my results, as far as my memory serves me, are very similar to those of Mr. Emery. But the matter was finally obtained by hot water, rather than by steam. I used pieces of iron pipe, because I wanted to protect iron pipe; and, therefore, got as near the actual conditions of the practice in that case as possible. Lengths of iron pipe, 1½ inches in diameter, and about 14 inches long, were set upright on a base, and covered with the protector that I desired to test. They were on a wooden base. There was a cork in the top, and a thermometer running down to the center of the tube, and a very fine (small) rubber tube also running to the bottom. Steam was blown in, and the water in there was kept boiling for about an hour, in order that the specific heat of the iron, and of the non-conductor, should not be a disturbing factor. I wanted the whole water to be uniformly hot, and then the steam was shut off; the water being at the boiling point, and the rate of its cooling noted and recorded graphically. A short time ago, Mr. Hiram Kilburn, the agent of the Potamska Mills, in New Bedford, gave a receipt for a material for covering, which has proved very satisfactory in actual practice, although I cannot give any observations as to its non-conducting power. But I think it may be of some use to you, and so will give it. I have it in my note book. It has the first advantage of being cheap. This is the receipt: four parts of coal ashes, sifted through a quarter-inch mesh sieve; one part plaster of Paris; one part sour flour; hair, same as for mortar, for inside work; wet the ashes, and put in the hair; then work up to a regular mortar; mix the plaster and flour, and then mix all together; put on with a trowel: finish the outside with a mixture of plaster of Paris, lime and sand, the same as for a hard finish. It adheres quite closely, and next to the pipe is quite porous. The sour flour in its fermentation generates a considerable gas, and the covering is very porous; and the hard finish outside protects it.

In regard to the convection of air, I have a little example in mind. The Hampden Cotton Mills, in Holyoke, was a mill of the olden style, with a square pitched roof, and sealed spaces at the sides and top (shown at *a* in the engraving), rendering the roof very nearly square. The insurance companies frown on every concealed space. About there, *b b*, would be the steam heating pipes in sections.

That room was so cold that it was uncomfortable. In winter it was practically impossible to keep that room warm; but, by reason of insurance interests, those partitions were removed, and the wood of which the partitions was composed was used for sheathing the roof on the inside. The roof in the first place was made of two-inch plank covered with slate. The sheathing was screwed up underneath the roof, *c c*, (of course it would break the slate if they used nails), increasing the thickness about ¾ of an inch; the same steam pipes were left there, and that room, last winter, was so warm that the help worked in there without inconvenience. The cause of the difference is that there is a freer circulation of air in the room, which enables the whole room to be heated; which is, I think, confirming to my mind of the statement from a wholly different point of view—the statement that was made by Mr. Emery from his experiments as to the poor effect of a large air-space as a non-conductor.

Mr. Stirling—I would like to ask Mr. Emery if he experimented with coal dust or fine anthracite coal?

Mr. Emery—No, sir. Coke holding so much more air, and charcoal giving such poor results, it was not thought desirable to take anything so solid as anthracite; but there were some particles in the ashes that were experimented with that could not be removed.

Prof. Egleston—I would like to ask Mr. Emery if his wool was disintegrated or slacked, and also if it was packed very much?

Mr. Emery—No, sir, not packed much; it was put in with as little pressure as possible. It tends to pack. We have not made any experiments ourselves in regard to disintegration or anything of that kind, except this: By dropping the wool into water and letting it remain a time, it will break up quite readily. It may properly, I think, be called disintegration; it is a mechanical matter, not a chemical change; it may crumble to powder under certain conditions.

Prof. Egleston—As the slag won't run constantly, you get a very inconstant blast furnace wool. If the process referred to was slacking, the metallurgists would be able to know what the matter was. If it is disintegration, why that is a physical defect, and I think that could be remedied too.

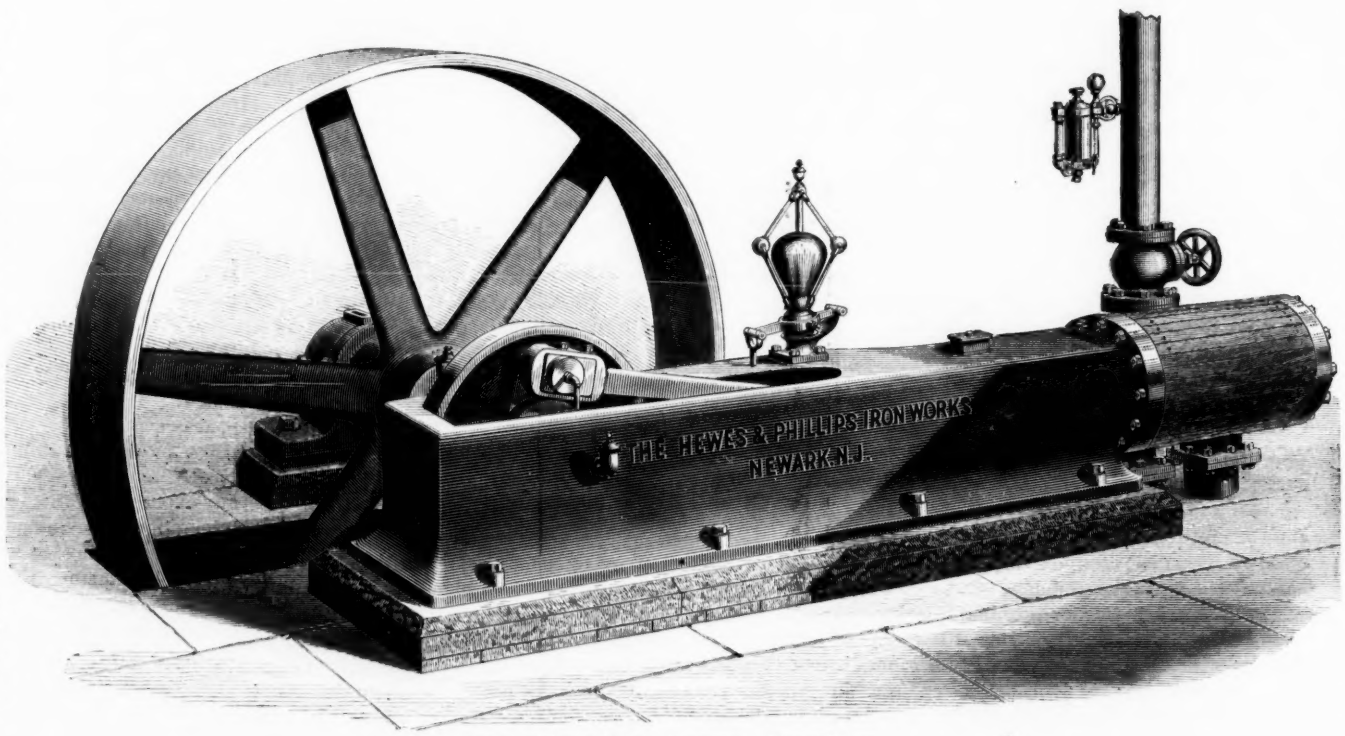
Mr. Emery—These experiments were made to obviate an imperfection in the method which Mr. Woodbury stated. He informs us that the experiments were made with hot water, letting it remain until it cooled down a certain number of degrees. Such experiments might be confirmatory, they could not be accurate; for the reason that the specific heat of the surrounding materials is imparted to the water within to a certain extent, and thereby affects the result. The result is really an average for the two—the specific heat of the water and the specific heat of the material surrounding it; the material giving away its heat, and helping to impart its heat to that of the water. The other method having a constant temperature inside, and a constant temperature outside, put the pipe in the condition in which it would be used in the streets, and the temperatures from one to the other after running a little while, are regularly graded, and correspond exactly to what would obtain in practice.

Elsewhere in our columns is a quotation which says the literature of the drawing-table has yet to be created. To a great extent this is true, but readers of the American Machinist have seen, week by week, a good deal of valuable and suggestive drawing-table literature in process of creation during the past few months.

The Allen High-Speed Engine.

In our issue of March 5, 1881, we illustrated and described the Allen high-speed engine, as built at the Hewes & Phillips Iron Works, Newark, N. J. The engraving shown in connection with the article referred to, represented a rear view of this engine, by means of which the reader could readily understand the construction of the valve motion. The engraving upon this page is a front view of the same engine, and while the previous article was a fair description of the engine, we may add the following: The heavy cross head is made of the same diameter as the cylinder. The object of making it so large is to absorb the steam impact upon the piston at the commencement of the stroke, and give it out at the latter part of the same, after the steam is cut off. By this arrangement, together with the heavy construction of the reciprocating parts, the pressure upon the crank pin remains almost uniform throughout the stroke.

Instead of having a heavy piston within the cylinder (where it can be only imperfectly lubricated, and, in consequence, wears the bore of an oval shape), the piston is made as light as is consistent with the required strength, and extra weight is put into the cross head where it can be perfectly lubricated. The valves are balanced, and move with perfect freedom. By the construction of the valves and ports, as well as the mechanism for operating, the valves operate with such swiftness and precision, that the initial pressure of steam in the cylinder rises to within a pound or two of the boiler pressure. The valves are arranged to cut off from 0, up to one-half; stroke varying with the load. The high speed of this engine admits of the use of a small fly wheel, and a parallel belt; also permits a direct application to a roll train in a rolling mill. By the peculiar form of bed, a housing of sheet iron may be applied to cover the opening near the crank, thus excluding all dust and grit. This is of special advantage in rolling mills. These engines are built in sixteen different sizes, from 8″x14″ up to 40″x48″, having two diameters for each length of stroke, as follows: 8″x14″, 9″x14″, 10″x16″, 11″x16″ and so on. The different sizes are all constructed to run at a uniform piston speed, viz., 600 feet per minute.



Allen High-Speed Engine.—Front View.

Friction Diagrams.

By E. W. Thompson.

It seems to be the general impression among engineers, or those in charge of taking indicator diagrams, that the power exerted by an engine when doing no useful work is represented by the "friction diagram" in horse power.

Strictly speaking, of course, a diagram merely represents the pressures at different points of the stroke, and from these, horse power and other things are calculated. But, while it is perfectly legitimate to calculate horse power from diagrams taken when the engine is doing useful work, it is meaningless and confusing to say of a friction diagram that it indicates so many horse power of friction in the engine, without in some way qualifying it. It is true that the diagram shows horse power exerted to overcome friction, but that gives no idea of the efficiency of the engine unless the speed is given; because, if it were said of an engine that it used up one horse power in friction, that same engine would use two horse power if run twice as fast, not that more force is required to overcome the friction, but this same force (leaving out of account the slight inaccuracy due to the probable change of friction coefficient for different velocities), is overcome through twice the space in the same time, and hence the horse power—which is proportional to the product of force and space, when time is constant—is doubled.

Furthermore, a friction diagram is almost worthless at best, for the friction, which is proportional to the normal pressure, increases with the load, and hence when it is performing its maximum work, the friction is a quantity entirely different from that shown by a friction diagram taken when the engine carries no load.

The mean effective pressure in pounds per square inch in the cylinder when there is no load on the engine, multiplied by the effective area of the piston in square inches is the exact measure in pounds of the friction exerted. It means that if that many pounds of force were exerted on the piston, it would maintain in the engine a uniform velocity. This is the only reliable information furnished by a friction diagram, and that is rarely wanted.

The most satisfactory way to determine the friction of an engine, is to observe the difference between the horse-power shown in the indicator and that shown by the dynamometer at the same time. This is conveniently expressed in per cent. of indicated or actual horse power, and needs no explanation.

Surface and Bottom of Green Sand Moulds.

By Thomas D. West.

There is no part of a mould that requires more precaution and judgment, coupled with a knowledge of thorough practice, on the part of a moulder, to insure a first-class casting, than finishing the surface and bottom of a mould, and there is no other part of a mould that moulders have so many different ways of handling. Take, for example, almost any pattern, and give it to a moulder to bed it in the sand; after which take it to another shop, and let a second moulder (being sure that he did not not know how the first man handled it in moulding), and so on until six or seven shops have been visited, and you need not be surprised that each moulder, who considers himself a good workman, has a different way of performing his work. A few will handle the job, understanding why they do certain things, while the rest will follow a series of details which has been simply taught them. The latter is a class which will have many supernatural, profound and flimsy excuses for bad work. Moulders frequently entertain the idea that the heavier the casting, the harder should be the surface of the mould, but in my practice this has proven erroneous. There are light large castings made, which require the surface and bottom of the mould to be very hard, so as to resist destruction threatened by the sudden head or pressure caused by fast pouring of the molten iron. If the beds of some solid heavy castings were made too hard, the moulds would be liable to be blown all to pieces, so that instead of the solidity, or weight of a casting, being a rule for the hardness of the mould, it is better to consider the time it takes to have a head or pressure on the surface of the mould during the process of pouring. It is very easy to control the hardnes of the bed of a mould that can be formed with straight edges, but the process of bedding a pattern in the sand by ramming the sand under it is more difficult, and requires more time. Some moulders will take almost any pattern, and bed it in the sand by digging out a hole and shoveling in from one to two feet of loose sand. They then take the pattern and pound it down into the soft sand, until they think it solid enough. This way of bedding a pattern is a quick but very poor one, and should be forbidden, as it is in some shops that desire to insure good work. This way of bedding a pattern also causes the bottom and surface of a mould to be exactly the reverse of what they should be, for the reason that rapping down the pattern makes the surface of the mould hard, leaving the sand soft under it, so that when the iron first enters the mould it bubbles and scabs. When a heavier pressure of molten iron comes upon the mould, it will cause the soft sand below to give way more in the middle than at the outside edges, so that when the casting is taken from the sand it is apt to be both swollen and scabbed. In moulding, the under portion of a bed requires to be rammed good and solid; the more strain to be resisted, or the heavier the casting, the more solid should this portion be rammed. If the bed is formed with straight edges, it can be rammed solid up to within three-quarters of an inch of the top, then well vented. After this the surfacing sand should be put on, and finished by rapping it down with a straight edge, or going over it lightly and evenly with a butt rammer. This surface sand should be soft, so that when the iron enters the mould it will remain still, and not bubble or boil. For coped moulds that have a large surface at the bottom, it is a very exceptional case that requires the surface sand to be any harder for a light casting than for a heavy one.

LETTERS FROM PRACTICAL MEN.

Making Cores and Core Prints.

Editor American Machinist:

Having had fourteen years' experience in foundry matters, will you allow me a word about cores and core prints. I prefer cones for top (or cope), and the bottom prints with one-sixteenth of an inch draught for every three-eighths of height of print. This gives plenty of draught, and does not disturb the sand around the print. Prints made this way save lots of grumbling; and produce good work, which is the object sought. For round cores (or square), up to four inches, I use moulding sand taken from the heap, and mixed with powdered rosin; the amount of rosin depending on the sand used. I use one part rosin to 12 parts sand. This makes a core that will stand any amount of moisture; it may be left in the mould for weeks, and be perfectly dry inside, as the rosin forms a coat that is impervious to water. In drying, they burn more easily than flour cores, but they make a fine finish inside, that does not grind off the lathe tool the first cut. Facing sand can be used, if desired. They vent free, and nearly always ignite as soon as the iron is poured against them. I have cast small cylinders, of three to six horse power, and left the cores in the moulds forten days, without causing any blowing. For a small shop, these are worth many times their cost over flour cores; especially in winter, for you can then core up your work as it is moulded, thus saving time, and the breakage of moulds. I know this will not be new to many of the "Old Chips," but may help many of the younger portion of the craft.

W. H. Rogers.
Glenwood, Iowa.

Learning Mech'l Drawing.

Ed. Am. Machinist:

Your versatile correspondent, "Quirk,' does rake some of us juniors unmercifully; exposing the weakness of our arguments, and knocking on the head any pet theories we advance; yet "an apprentice" has sent him one, under the water line in your issue of May 14. "Quirk" seems to forget that many apprentices begin their machine shop life with but slender purses, and often empty them before their first year is through; and the purchase of a good set of mathematical instruments, square and board, leaves them little funds to buy good books of instruction.

Here is the point at which the kindness of a friendly workingman who can use "drawing tools," will be appreciated. It is a rare thing for the foreman to take any interest in the boys of his shop, after working hours. "Boys are thick headed, any how," is a saying of just such men; yet these same boys could beat him out of his boots, in all calculations requiring the rules and principles of advanced arithmetic and mathematics.

We have found that the current numbers of "our paper" contain many things that an apprentice could copy and enlarge—taking the plane surface drawings, until he can undertake more difficult drawings. There are lessons all around us, if we will but use them; and when "apprentice" becomes proficient, he will the more readily extend the helping hand to some struggling young man, who, like himself, desires to be something better than a mere slugger over the chipping hammer, or driving the file from

morning to night. The man, who, in the kindness of his heart helps and encourages the love for mechanical drawing amongst the boys in the shops, where he works, is doing more real good than the herd of politicians we are sending to Washington.

Chicago, Ills. NORMAN.

Transmission of Power by Belts.

Editor American Machinist:

Machinists, and other mechanics, often find it very troublesome to place pulleys at angles to each other, and have the belt run well. The reason for this is that the principle is not well understood, and so long as this is not clear rules amount to very little. The foundation of the transmission of power by belts is to obtain an efficient adhesion, or surface contact of the belt and pulley. This is commonly known as the coefficient of friction, and is that available percentage of the tension which adheres to the face of the pulley, causing the pulley to draw the belt over it. It has been proved that rough surfaces upon the belts do not work well, and through their use a great loss of power is sustained. If a pulley with a rough, unturned face be used, and a belt be placed upon it, the belt will rest only upon the high spots, consequently it will be strained unequally, owing to the concentrating of the strains at the highest points. This course would very soon destroy a good belt. To produce the best surface upon a pulley, it is covered with leather, to give more adhesive power, which also means more friction.

A belt will take a better hold upon a leather-covered pulley, owing to the increased affinity of the two surfaces in contact. The chief objection to leather as a pulley covering, is its cost, and if some other substance, equally good, but cheap, could be introduced, it would be very desirable.

When a belt is at rest, the strain upon its surface is about equal, but as soon as the pulleys begin to move, the strain is changed to the side which transmits the power.

The belt will not slip until its adhesive power has been overcome by the load, and will work very well so long as the strain put upon the belt is in harmony with its tensile strength. From the foregoing we conclude that the more leather we can put upon a pulley, in the width and thickness of the belt, the more strain it will resist, thus creating more friction, and in consequence will overcome more resistance or load.

We have seen that the wider and thicker a belt is, the greater power it will transmit, but these conditions are limited, for this reason: If a belt be constantly strained to its utmost capacity, the weaker parts will soon give way, and the belt will soon be destroyed.

This effect will also become evident upon the journals, as an excessive tension upon the belt will cause undue friction, causing them to heat; thus, by following such a course, the durability of belts and machinery is affected, and economy ceases to exist. The conditions relating to narrow belts, and those of a reasonable width, act somewhat different in the case of very wide belts, say from 3 feet to 6 feet in width, leaving out any consideration of the length or weight.

I may say that a round or V belt cannot transmit any more power than a flat belt representing an equal area of cross section, and having an equal tension and an equal amount of surface contact of the pulley and belt.

The peculiar shape of a belt does not create any greater economy in the transmission of power, as the same power required to crowd a belt into a groove is also required to pull it out again.

When belts of this style become worn, they do not fill the groove properly, so the adhesion is partly destroyed, as the bearing surface is greatly reduced. Some shops in Europe are furnished with round belts exclusively, which work remarkably well.

In a flat belt one square inch is represented by 5″ of width and $\frac{3}{16}$″ of thickness, or 4″ of width and $\frac{1}{4}$″ of thickness. For round belts, compared with flat belts, the attention of the reader is directed to the following table:

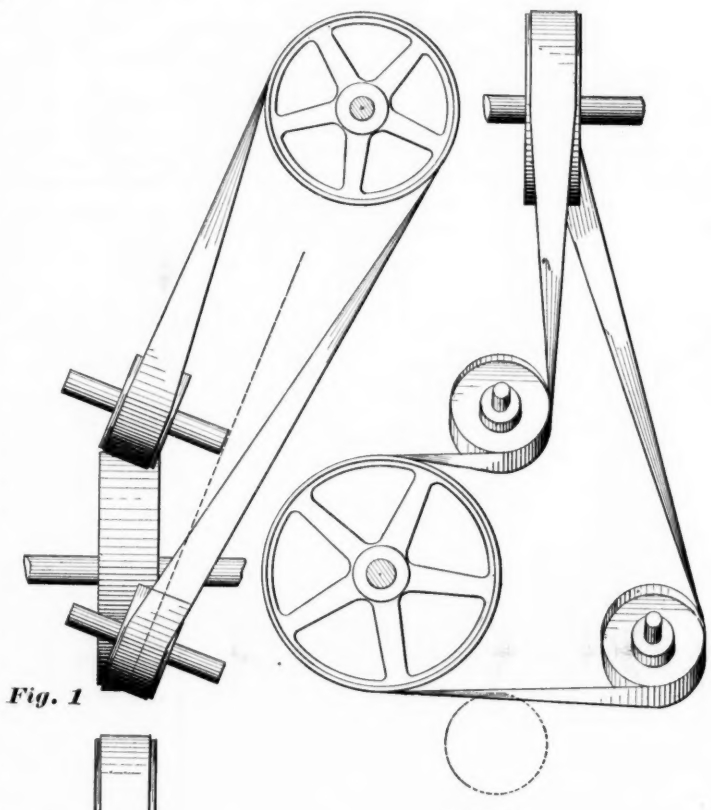


Fig. 1

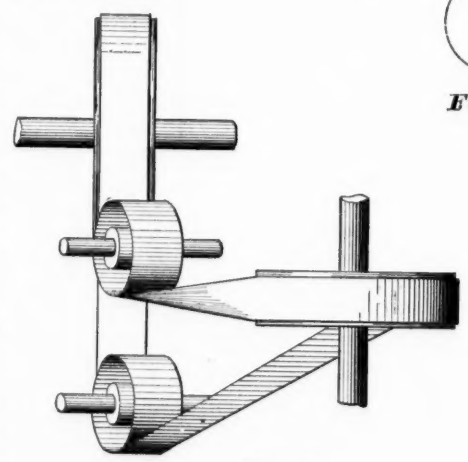


Fig. 3

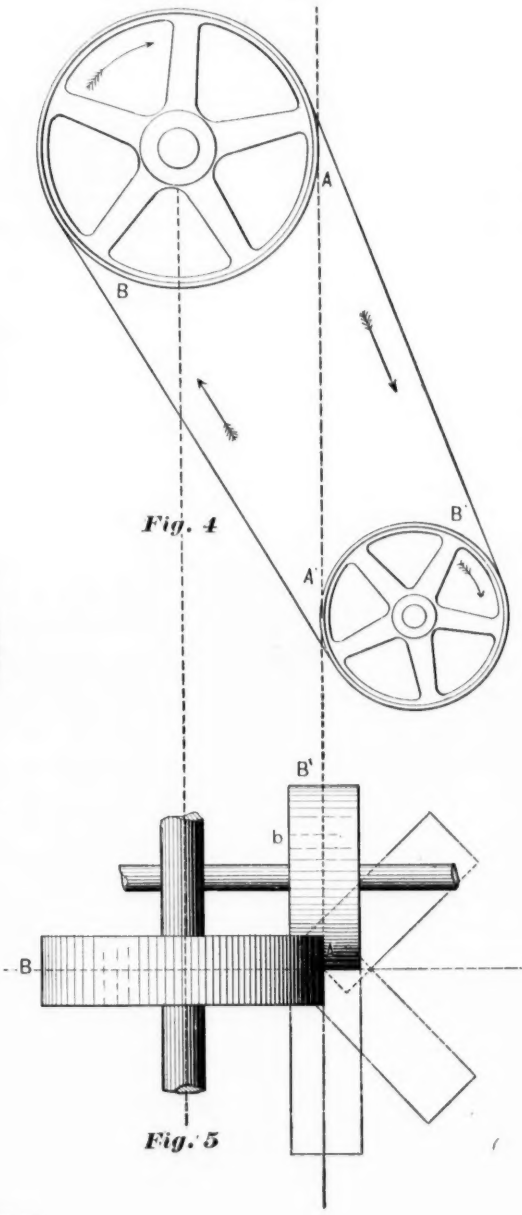


Fig. 4

Fig. 5

APPLICATION OF BELTS.

Round Belts.	Square in.	($\frac{3}{16}$″ Flat Band.	$\frac{1}{4}$″)
$\frac{1}{2}$ inch dia.	0.196	0.98	0.78
$\frac{3}{4}$ "	0.441	2.205	1.76
1 "	0.785	3.925	3.14
$1\frac{1}{2}$ "	1.767	8.835	7.06
2 "	3.141	15.70	12.56
$2\frac{1}{2}$ "	4.908	24.50	19.60
3 "	7.068	35.30	28.24

Any shape not referred to in the table may be easily found by applying the number of square inches representing the width of belt to the corresponding thickness of the same.

That side of a belt which pulls is the working part, and the slack side is the leading part, to which the shifter, tightener or guide pulley is applied. The positions of the driving and driven pulleys may be such that the belt will leave the face of the pulley sidewise, but it must be perfectly guided to the face of the next pulley, and directly in line with it. A belt may leave the face of a pulley sidewise, or at an angle, because the belt being tightly drawn around the pulley it cannot easily slide off. But as soon as it leaves the face of the pulley it changes its direction at once, and leads directly to the face of the next pulley.

The belt must be received squarely and flatly upon the face of the pulley, for, unless these conditions are carefully observed, and the belt is unequally strained at either of its sides, it will be impossible to make the belt run properly, even though a rim be placed upon each edge of the pulley.

If the shafts are so situated that the foregoing directions cannot be followed, an idler, or leading pulley, must be put up for one, or both sides of the belt. These pulleys must be so placed that the belt will be delivered squarely and flatly upon the faces of the pulleys, as represented in the accompanying engravings, Figs. 1, 2, 3.

The working side of the belt, in running, is wrapped tightly around the pulley, and transmits all the power, consequently all the slack side has to do is to create a proper tension.

Referring to Figs. 4 and 5, the reader will discover a practical method of placing a set of pulleys at angles to each other, within 180°, yet allowing the belt to work freely and in line.

Draw the set of pulleys desired upon a sheet of stiff drawing paper, with the figures and arrows as shown in Fig. 4. Trim around just outside the belt with a pair of shears, and bend the paper along the dotted line *AA*, so that it will serve as a hinge right and left. *AA* will then indicate the position in which the belt leaves the pulleys, while *BB* indicates the position in which it is received, and runs upon the faces of the pulleys. These are the primary and the most essential points to be borne in mind in putting up pulleys. By the use of the paper model, described, we perceive that the points where the belt leaves the face of pulley must always be either plumb or in line. In wide belts the edge *b* (shown in Fig. 5) of the small pulley must be placed even with the outer edge of the larger pulley, so as to enable the belt to take a better hold of the driven pulley.

The belt must reach over the center, at least, or else it will not stay upon the pulley, especially if the driven pulley is of small diameter. The slack part of the belt in leaving *A*, will pass nearly straight to *B*. It is easy to understand which of these is the driving pulley. It once occurred, in my experience, that a set of pulleys were put up in the right positions; but the machinist who did the work told me positively that it was wrong, for the reason that the belt would not stay upon the face of the pulleys. This frequently happens, from the fact that the belt is crossed in putting on, instead of being open, in which case it certainly will not work. I have a little paper model, like the one described, which I have carried in my pocket book for the past fifteen years; and by its aid I have been able to solve the most difficult belt problems, and to overcome many obstacles in the application of belts for the transmission of power.

New York. HERMANN T. C. KRAUS.

Proportioning Key Ways in Shafts.

Editor Am. Machinist:

I notice in a late issue a correspondent inquiring for a rule for proportioning a key-way in a shaft. Here is one used by the writer for a number of years past with perfect satisfaction. Calling the diameter of the shaft *D*, then $\frac{D}{4}$ = width of the key-way, and $\frac{D}{5}$ = depth of the key.

Or, stated in another way, the width of the key-way should be one-quarter the diameter of the shaft, and the depth of key one-fifth the diameter of shaft.

The key should be set one-half its depth into shaft, measuring at the side.

I have used this formula for all kinds of heavy gearing, and with only one key, and never yet have known it to fail.

WM. P. CANNING.
Lowell, Mass.

Puzzled by a Compound Engine.

Editor Am. Machinist:

Not long since my attention was called to a compound engine, rated at 200 horse power, running not far from one of our large cities. I was asked by the engineer in charge some questions relating to the theory of the compound engine, and as theory was all I possessed, I gave it to him to the best of my ability. He then handed me a small pamphlet, purporting to be a history of the compound engine, etc., etc., published by the builder of the engine; the burden of which, as I now recollect it (I have it not at hand) was like this: "The automatic cut-off engine is a national disgrace. The only proper point of cut-off for economical working, in any engine, is at one-quarter stroke;" and in the mathematical demonstration, the pressures were all taken, as shown by the gauge; and not absolute pressure, as I was taught to use, when calculating for a condensing engine. The dimensions of this engine, as I learned them, are cylinders, 16″ and 28″ diameter; 30″ stroke of piston; fly wheel, 28″ face, 10 feet diameter, making 102 revolutions per minute. Boiler pressure was 55 to 60 pounds by gauge. Both cylinders have RIDING cut-offs, the high pressure side cutting off at 17″ and a fraction, and the condensing side at 14½″. The valve chests lack some inches, at each end, of being as long as the cylinder. The engine is

controlled by a throttling-governor; one of Shive's, I think. I made a shrewd guess, as I explained to the engineer that the economy due to compound engines arose from the saving of heat, by expanding the steam in two cylinders, instead of getting the same expansion in one; and that the pressure, whatever it might be on the low pressure piston, was so much back pressure on the high pressure piston, and that the gain in power was obtained by the difference in areas of the pistons; he said, the man that set it up said there was no back pressure on either piston; and, sure enough, a drain cock in the pipe connecting the cylinders being opened, a vacuum of five or six pounds to the inch was apparent. This completely nonplussed me, and I withdrew to think.

I was taught that the greatest economy in the use of steam was gained by using full boiler pressure to the proper point of cut-off, to develop the required power; and not to wiredraw the steam by throttling. I also failed to see why an automatic cut-off would not work just as well at one quarter, as at any other point. When I think the matter over, I feel tempted to ask, as did the school boy: "Has this world advanced backwards?" I have not the honor of a personal acquaintance with either Mr. Wm. Lee Church, or Mr. F. F. Hemenway, but I feel sure either of them can set us right on the automatic cut-off question; and I (with others) am earnestly looking for light on the compound engine question.

No. Bennington, Vt. CHAS. S. BEACH.

Practical Shop Drawings.—Counterbalancing Engines.

Editor American Machinist:

It has been very amusing, as well as instructive, to notice the various comments called out by "Chordal's bolt." I don't expect to settle this question fully in my own mind, much less in the minds of others, but will briefly, if you please, have my say. I like "the school-boy's bolt" and that of G. H. Smith best of all. I think artistic effect should be avoided, and if "This is a horse" is needed, *put it there.* Shading is useless, and, if properly done, expensive. The scale should not be named on mechanical drawings, as this suggests taking measurements with dividers, calipers or rule—a practice which, I think, should not be allowed, as the communication of "Greaser" forcibly illustrates. For shop drawings I like the heavy card board, prepared with drawing paper, and of uniform size, say 12″ x 16″, or 16″ x 20″.

Much time and expense may be saved in the manipulation of drawings by omitting threads of screws, cogs of wheels, links of chain, etc., all of which may be readily designated by a word or line. To "Apprentice," who asks me to explain, would say, "Where there is a will, there is a way."

If no instructor of drawing can be found, get a set of instruments and practice alone. Copy "Chordal's" bolts, or any other cuts from the AMERICAN MACHINIST, and then try copying from some simple machine. The mere act of taking dimensions of such machines, and transferring them to rough sketches, will be found very beneficial, and, particularly, if from a machine with which you are not familiar.

Never mind the display of a fine set of instruments. You will find a compass, dividers, pencil, pen and square are the important pieces.

* * * * * *

The mere fact that I may hold different notions from others as to the correct method of finding the proper weight and location of a counterbalance is a matter of little or no consequence to your readers. But Mr. Rob. V. Kinney asks me to demonstrate the error in his first proposition; or, if he pleases, the first part of his proposed plan for balancing an engine crank. He says: "In the first place ascertain the weight of the rotating parts to be balanced, viz., the crank end half of connecting rod," etc. As stated in my former mention of this subject, I know of no formulated rule for determining the center of gravity of a body having the varied movements incident to a connecting rod. Such a point must be known in order to arrive at the true effect produced on the crank.

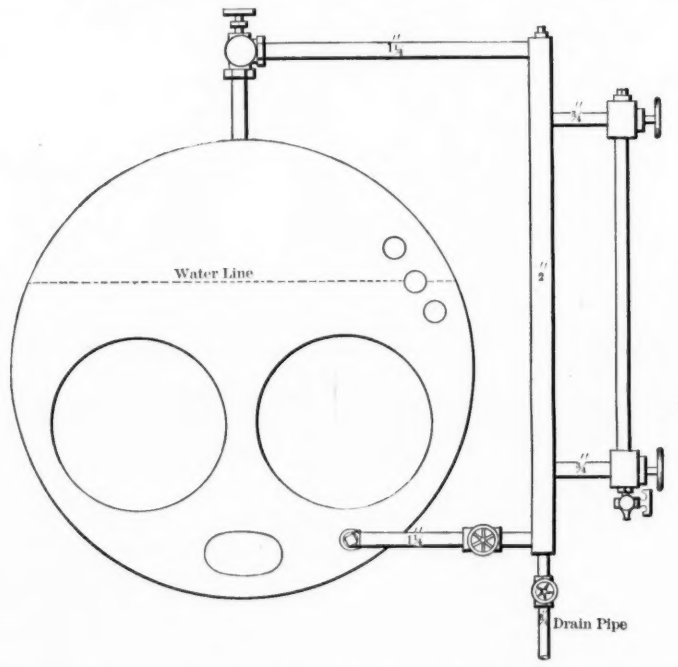
It is self-evident, I think, that the proportional weight of rod to be counterbalanced will be greater with a short rod than with a long one, stroke of crank being the same; and, in either case, it will exceed half the weight of rod. I have yet to see the engine, one free to move, that is perfectly balanced, much less an established rule for accomplishing this; and, in its absence, would accept even a "rule of thumb," if it had no apparent error in it.

As to "cushion," I still say this figures as an important part. It is the kind of cushion that Mr. K. proposes, "$\frac{1}{32}$" to $\frac{1}{4}$" lead," that I objected to. Let us see if I am right or wrong in this.

Take, for example, an engine of 20″ stroke, with slide valve of usual dimensions, and having $\frac{1}{4}$″ lead (Mr. K's extreme), and with lap to cut-off at $\frac{3}{4}$ stroke. When steam is first admitted, the piston will have traveled through $\frac{149}{1000}$ of its stroke.

From the position of crank at this point, it is plainly too late to arrest the motion of the reciprocating parts, or to prevent shock.

This, I find, can best be done by utilizing the exhaust steam; and thus, gradually, during the last quarter of the stroke, take up the momentum of the moving parts.



I see an inquiry in your last issue about balancing cylindrical bodies. This is something to which I have given some attention, and will look for light on the subject in subsequent issues. QUIRK.

Chattanooga, Tenn.

Shafting and Couplings.

Editor American Machinist:

I have read the discussion now going on upon the shafting question, without arriving at any bottom facts as to the right and wrong in the case, as to the proper length of box, etc., for a properly constructed shaft, also as to the best constructed coupling.

My experience with shafting, of some twenty years, goes to prove that the proper length of box should be about five and one-half (5½) inches for a one and a-half inch shaft, and for a moderately heavy load a sleeve coupling, bored tapering and pinned, is the best and most convenient coupling to use. It is convenient in changing pulleys, and is abundantly strong for shafts up to and including two inches. The box for a two-inch shaft should be about seven inches long, and for a two and a half shaft nine inches long, with a babbitt metal lined box.

On any shaft over two inches in diameter I would put a flange coupling, one coupling to be recessed, and the other having a projection to insure the different lengths being in line. These couplings I would key on, with a determination that they should never be started off their shaft, and then put on split pulleys.

I don't want the coupling bolts to be too tight, but a fair fit, and with a good foundation for the hangers, this shaft, with decent usage, will be almost as good after twenty years' running as when new. The boxes may have to be babbitted once during the time. Now, if any one knows any better way of getting out and putting up line shafting, I should be pleased to hear from him.

Rockland, Mass. MACHINIST.

Boiler Fixtures.

Editor American Machinist:

In my last communication on Boiler Management, I referred to defective water-glass gauges. Since my last writing I have visited the public institution where one of the gauges spoken of is located. I find that the lower pipe to water gauge enters the boiler head about three inches above top tube! This explains why the gauge became stopped. The engineer had allowed the water to fall a little low (say even with the opening in pipe), and the surface mud and scum naturally seeking the most quiet place, had entered the end of pipe and lodged there, becoming hard in time. The upper pipe to this gauge was tapped into the head of boiler about *one foot* above where the lower pipe entered. On one occasion the engineer pumped the boiler so full that the water flowed over through the upper pipe and filled the glass tube, and he was not aware that he had too much water until it came out at the safety valve. Water glass gauges should not be tapped in too high. The lower pipe should be sufficiently high above the bottom of boiler to prevent sediment from getting into it, but not so high but the end can be well seen when washing out. A good plan is to extend the pipe inside the boiler about one foot from head. This is better than to have the pipe just flush with inside of head, for, sometimes, fine scale will accumulate at the end of pipe, and stop it. It is a good plan to take the steam connection for water gauge from top of the cylinder part of the boiler, rather than from the steam drum or dome. I know of an instance where the boiler was worked hard, and steam pipe to water gauge was attached to the steam dome. In this case the water was never at rest, often varying two and three inches; sometimes running up eight inches in glass. The pipe was changed from dome to the top of boiler; and since this change, the water does not vary more than a quarter of an inch. The cause assigned for the water varying so much in the above case, is: difference of pressure in upper pipe to glass gauge, caused by drawing steam rapidly from the dome; the pressure thereby not being equalized in both pipes connected with gauge.

Sometimes a small leak in the stuffing box of valve, on upper part of the water gauge, will cause the water in glass tube to stand an inch or more above its real height in the boiler. The young engineer should look to this closely, and see that all the stuffing boxes are well filled with some good packing material, and screwed up tight.

I give, in the accompanying engraving, what I consider a well-connected water gauge. It is attached to a boiler, which is worked constantly with very muddy water; but during three years' service has never given the least trouble. I would recommend this mode of connecting a gauge to my young friends, readers of the AMERICAN MACHINIST, knowing that it will work satisfactorily if attended to; that is, blown out frequently. "ENGINEER."

St. Louis, Mo.

A Direct Method of Copying Drawings.

BY PROF. SAMUEL W. POWEL.

MEMORANDUM PRESENTED TO THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Stenographically reported for the AMERICAN MACHINIST.

I will present the copy (blue print) of a drawing, taken direct from the drawing, without the use of a tracing. In the course of some experiments in copying a set of drawings, we had occasion to send them to a drawing room for reproduction; but the result was not a work that would last a sufficient length of time to warrant enlarging the force of draughtsmen. So, as the result of a few experiments in copying, we managed to get a plan that we are using now altogether—a plan of taking the blue copies direct from the drawings, without the trouble and expense of tracing at all. Otherwise the method is the same as is ordinarily used. The proportions of the solution for preparing the paper are about 2½ ounces of citrate of iron and ammonia, 2¼ ounces of red prussiate of potash, to 16 ounces of water. The water is hardly carried up to the full amount, 14 or 15 ounces sometimes being sufficient, and the drawings are made upon Weston's linen record paper. I have experimented with Whatman's paper, and also with the Paragon paper, but it requires longer exposure, and the results are not as good. The exposure averages an hour to an hour and a half, whereas for tracings we expose from five to ten minutes.

DISCUSSION.

THE PRESIDENT:—That will certainly facilitate work. Those lines, in many cases, are very well brought out.

MR. LEAVITT:—Bearing on this point, I will state that a man at the West Point Foundry told me he had a lot of bad drawing paper that he could not use for tracings. He had his drawings made on this paper, and then he took the blue prints directly from them without a tracing.

MR. DURFEE:—In case of an emergency I should think the drawing might be made more transparent by dipping the drawing in benzine or something of that sort. It would not injure the lines of drawing, and would make it much more transparent, and shorten the process of copying.

PROF. POWEL:—I have experimented considerably on that process. I tried white wax and benzine, and benzine was the most satisfactory; but we did not get as good an effect, and if you allow the benzine to dry, the drawing will return to its original state.

Correct Time by Compressed Air.

Compressed air, says the *Engineer and Iron Trades Advertiser*, has lately been applied in Paris to the distribution from a central station of the correct time to a system of clock dials spread over the city. These pneumatic clocks are fitted with an exceedingly simple mechanism, which is kept in motion by compressed air sent through a system of tubes from the central station, the reservoir there being put into communication with the pipes for twenty seconds of each minute by means of a distributing clock, which is itself regulated from the observatory.

The main tubes placed underground are of iron, and have an internal diameter of over an inch; those leading into private houses are of lead, with only half of that diameter; in apartments this is still further reduced to one-fourth of an inch; while the tube attached to the clock is formed of India rubber, covered with silk, and has an internal diameter of only one-eighth of an inch. These pneumatic clocks require neither winding up, regulating, nor cleaning. They are now to be found in the principal streets of Paris, as well as in many private houses, where subscribers, for a half-penny a day, receive observatory time without the trouble of looking after their timepieces.

Foreign Technical Notes.

Translated for the AMERICAN MACHINIST.

INGENIOUS HAULING APPARATUS.

The last number of *Comptes Rendus* gives a description of an ingenious method of chain haulage, devised and erected by M. Thiébaut, engineer, on a tramway connected with a large colliery near Charleroi, Belgium. The coal raised from the pit is conveyed in the underground tubs along a tunnel with a double line of railway for a distance of 1,095 yards to the Brussels and Charleroi Canal, where they are dumped over a screen 26 feet high. The haulage is effected by means of an endless chain moving at a rate of about one hundred feet a minute. This chain, which is of iron links, seven-eighths of an inch in diameter, has rather larger links than usual, and is simply placed upon the tubs, which it draws along by friction on their backs, both when loaded and unloaded. It is moved by a pulley or drum of 33 inches in diameter, driven by a coupled engine, with cylinders 11 inches in diameter, and 19½ inches stroke. The endless chain is only guided at one point in the tunnel, where there is a bend of 4½ degrees, but it is raised off the ground by rollers near the two drums. An ingenious arrangement of levers permits of the wagons being placed under the chain at a suitable distance apart. On leaving the tunnel the wagons are raised over the screen by an incline with two lines of railway by means of an endless chain underneath them. At intervals corresponding to the distance between the wagons, the chain carries two hooks forming part of the links, placed between the wagon axles. These hooks, the convex portions of which are back to back in the same pair, seize the wagons by the axles, so as to draw them along in either direction. The leading particulars of this new arrangement are as follows:

Weight of wagons when empty..	5 cwt.
Weight of coal charge.....	9 cwt.
Coefficient of friction.....	0.016
Gauge of way.....1ft. 7½in.	
Gradient.....1 in 333.	

MALLEABLE BRASS.

This, says the *Berg. u. Hüttman. Zeitung*, is made by alloying 33 parts of copper, and 25 of zinc, the copper being loosely covered with the zinc in the crucible. As soon as the copper is melted, zinc purified by sulphur is added. The alloy is then cast into moulding sand, in the shape of bars, which are malleable into any form while hot.

TEMPORARY MAGNETISM OF NICKEL AND COBALT.

Le Charbon reports that M. Becquerel has been pursuing for some time an extensive series of experiments upon the temporary magnetism developed in various specimens of nickel and cobalt, as compared with that of iron. He finds that when bars of nickel, which are chemically pure, are employed, they give results very similar to those of soft iron. One very remarkable bar of nickel, which was probably porous, appeared to be a little more magnetic than iron. He found very little difference between the nickel and the cobalt. He proposes to follow these experiments, by a special investigation of the permanent magnetism of the three metals.

PECULIAR ANVILS.

Jernskontoret says that a Swedish firm has lately constructed and patented special forms of anvils, for swaging or hammering tubes into railway axles or other forms. The peculiarities of these anvils are that they are formed with a channel in the anvil, having a horizontal face and two convex faces, inclined at an angle of about 60 degrees, so that when a forging is struck, it comes in contact with three surfaces.

LEATHER COG WHEELS.

Die deutsche G. u. Ind. Ztg. reports that M. Kunkel, of Mezingen, Wurtemberg, has just patented a process for making toothed wheels of leather in place of metal. The particular advantages claimed for them are that they have a much quicker and more elastic run, are extremely durable, and above all require no lubrication whatever. They are prepared from raw untanned buffalo hides, thoroughly cleansed from all hair, flesh, etc., and glued together in as many layers as are necessary to produce the breadth of wheel required. The cementing is effected under very heavy pressure, as on a hydraulic press, and this is kept up until the glue has completely hardened. From the sheets or plates thus prepared the teeth are cut out by saw and chisel.

ARTIFICIAL BRONZINGS.

Die Zeitsche f. Bauk says that to insure the complete adhesion of bronze and other coloring powders, to iron and similar objects which it is desired to decorate in this manner, Dr. Bottger recommends the previous application of a thin coating of silicate of potash solution, on which, while still wet, the coloring powder should then be spread. Bronzing thus obtained will stand washing, will resist the action of alcohol, and can be brought to a fine burnished finish without injury to the surface.

Newly Incorporated Companies.

PENNSYLVANIA.

The New York, Pittsburg and Chicago Railway Company, principal office, Pittsburg; James S. Negley, W. H. Riddle, H. T. Hanna, and others, incorporators; Capital, $1,500,000. For the construction of a railroad, fifty miles in length, from the mouth of the Mahoning River, in Lawrence County, to the City of Pittsburg, in Allegheny County.

The Bradford, Richburg and Cuba Railroad Company, principal office, Bradford, Pa.; J. J. Carter, W. W. Brown, W. C. Warner, and others, incorporators; President, J. J. Carter; Capital, $100,000. Length about fifteen miles. To be constructed from Rew City, McKean County, Pa., to a point on the line between the States of New York and Pennsylvania. Gauge three feet.

The Ohio and Baltimore Short Line Railroad Company, principal office, Washington, Pa.; J. B. Washington, President, J. B. Washington, W. W. Smith, William Workman, and others, incorporators; Capital, $1,000,000. To be constructed from the borough of Washington, Pa., to the borough of Connellsville, Fayette County, Pa., a distance of forty-six miles.

Eldred, Ceres and Wellsville Railroad Company, principal office, Eldred, McKean County; W. L. Chrisman, A. B. Rowley, E. R. Mayo, and others, incorporators; Capital, $48,000. For the purpose of constructing a narrow gauge railroad from the borough of Eldred, McKean County, to the line dividing the States of New York and Pennsylvania, at the village of Ceres, a distance of eight miles.

The Leatheroid Manufacturing Company, office No. 517 Locust street, Philadelphia; Capital, $25,000. H. R. Deacon, R. H. Kline, R. H. Sherwood, and others, incorporators. For the manufacture of mechanical and other appliances and articles of merchandise out of wood, paper and other materials.

The Connoquenessing Valley Railroad Company, Greenville, Mercer County; Capital, $800,000. J. T. Blair, Greenville, Pa.; A. H. Steele, Titusville, Pa.; John M. Thompson, Butler, Pa., and others, incorporators. To construct a railroad from Butler, Pa., to a point on the line of the Shenango and Allegheny Railroad Company, a distance of fourteen miles.

The Pittsburg and Northern Railroad Company, principal office, Pittsburg, Pa.; A. G. Hatry, J. D. Callery. James Callery and others, incorporators; Capital, $150,000. For the construction of a railroad twenty-five miles in length, from a point in the borough of Millvale, Allegheny County, to a point near Evansburg, Butler County, Pa. Gauge, three feet.

Iron Bridge and Morewood Railroad Company, principal office, Pittsburg; Capital stock, $50,000. President, James B. Washington, J. B. Washington, G. D. Scully, C. C. Markle, incorporators. For the construction of a railroad from a point on the Mount Pleasant and Bound Ford Railroad Company, at Iron Bridge Station, Fayette County, Pa., to the works of the Morewood Coke Company, a distance of two miles.

NEW JERSEY.

The Midland Connecting Railway Company. Fred'k A. Potts, Garret A. Hobart, Chas. Menzesheimer and others, incorporators. Capital stock, $10,000,000. To build and construct a railroad from the Midland R. R. at or near Snufftown, Sussex County, N. J., thence running through the counties of Sussex and Warren to a point on the line of the North Jersey Railroad, at or near the Delaware Water Gap. The length of said road is 35 miles.

The North River Railroad Company. Agreement of consolidation of the Jersey City and Albany Railway Company of New York and New Jersey, and the North River Railway Company of New York. Capital stock, $10,000,000. Edward F. Winslow, Pres't., John L. Nisbet, Sec., Conrad N. Jordan, Treas.

MASSACHUSETTS.

The Ocean Terminal R. R. Dock & Elevator Co., Boston; J. E. Bartlett, Amos Stone, G. H. Jacobs, G. W. Ireland, W. P. Blake, C. Collier, D. N. Skillings, F. O. Reed and W. B. Long, incorporators. Capital, $500,000, with authority to increase to $2,000,000. For the purpose of constructing and maintaining wharves, elevators, warehouses and other buildings and structures suitable for receiving, storing and delivering freight or forwarding the same, with authority to lay and maintain railroad tracks to connect with any railroad extending to its land, for the purpose of receiving freight and delivering the same.

The American Door Hanger Co., Boston; James Alexander, Prest., Charles O. Burbank, Treas. Capital, $200,000. For the manufacture and sale of Door Hangers, Blind Hangers, and improvements therein, under patents granted to Edwin Prescott for the Kingdom of Great Britain.

NEW YORK.

The Railroad Safety Track Joint Company, New York; Henry H. Brandon, Ernest Brandon and William B. Hewson, incorporators; Capital, $200,000. To manufacture and sell safety track joints and improvements in machinery for manufacturing key bolts.

The Friendship Railroad Company; Directors, Asher W. Miner, Abijah J. Willman, Jacob O. Price, Morris C. Mulkin, Robert A. Scott, Herman Rice, Alfred B. Bradley, James Pitts, S. McArthur Norton, Sidney P. Morse, John C. Drake, John C. Reed and Charles L. Howard; Capital, $100,000. To construct, maintain and operate a railroad commencing in the town of Friendship, Allegheny County, and terminating at the State line in the town of Portville, Cattaraugus County. Length of road about twenty-two miles.

Automatic Coupling and Manufacturing Company, New York; Silas B. Dutcher, Eli Bates, James W. Embury, Thomas Girvin and Edward Gumbs, incorporators; Capital, $150,000. To manufacture and sell couplings and other articles of trade.

The Bradford, Eldred and Cuba Railroad Company; George R. Blanchard, Edmund S. Bowen, Bird W. Spencer, Charles L. Attrobury, Richard G. Taylor, Daniel O'Day, Wilson S. Bissell, John J. Carter, Elmer M. Bond, William P. Stevens, Addison W. Smith, Charles G. Barbour and Royal C. Vilas, Directors; Capital, $500,000. To construct, maintain and operate a railroad from the village of Cuba, Allegheny County, to a point in the southerly boundary of the County of Allegheny, on the State line, between the States of New York and Pennsylvania. Length of road twenty-nine miles.

North River Railroad Company; Directors, Chas. F. Woerishoffer, Horace Porter, Edward F. Winslow, Theodore Houston, Conrad N. Jordan, Frederick Butterfield, Wm. Adams, Thos. C. Clarke, John W. Simpson, Chas. J. Candee, James W. McCulloh, Chas. G. Hedge and Stephen A. Lathrop. Maximum Capital, $15,000,000. New road formed by consolidation of the Jersey City and Albany Railway Companies of the States of New York and New Jersey, and the North River Railway Company.

The Thompson Self-Leveling Berth Company, New York; John B. Page, David J. Newland, and George S. Studwell, incorporators. Capital, $500,000. To manufacture and sell self-leveling berths for the carrying of passengers, and other self-levelling apparatus for transferring live stock and merchandise, for use on steamships and other vessels on the sea and inland waters.

International Ice Machine Company, New York; Thos. L. Rankin, Jas. B. Brown, Daniel H. Craig, Charles A. Randall and Phillip G. Randall, incorporators. Capital, $3,000,000. For the manufacture and production of ice by artificial means, and the manufacture of machines for the production of ice and for refrigerating purposes.

Knickerbocker Manufacturing Company, New York; Solomon Sayles, Myer Dittenhoeffer and Henry Richardson, incorporators. Capital, $50,000. To manufacture and sell Stamped Sheet Iron and Tinwares, and general Sheet Iron work.

The Fabric Ornamenting and Manufacturing Company, New York; Aaron H. Cragin, Frank G. Wentworth, Benj. M. Plumb and Wm. Hadden, incorporators. Capital, $350,000. To ornament and decorate papers and fabrics, and to manufacture machines to effect the same.

Randall Telephone Manufacturing Company, New York; Charles A. Randall, Philip G. Randall and Harry C. Birch, incorporators. Capital, $500,000. To manufacture, sell and rent telephonic apparatus.

The Hoopes Artificial Stone Company, of New York City; James E. Simpson, James E. Simpson, Jr., Jesse Boynton, C. S. Bushnell and Edward Heaton, incorporators. Capital, $250,000. For the manufacture, construction and sale of artificial stone and other articles.

The Bonsilate Button Company, Albany; Chas. E. Lansing, Edward A. Groesbeck and Chas. M. Hyatt, incorporators. Capital, $25,000. To manufacture and sell Buttons made of Bonsilate, and other material in connection therewith.

Habits of Young Mechanics.

Let all young mechanics and apprentices who read this remember that there are many things in shop associations which have a tendency to mislead young men. A boy may be placed in a shop where the men read very little, and seem to have formed a prejudice against all manner of scientific literature. A shop of this character is very dangerous to a young man who wishes to fill a high position in the profession he may choose. The men referred to will ridicule the first appearance of a disposition to study, and the sooner the ambitious young man gets out of such a shop the better, unless he has a will strong enough to stick to such a shop, live down prejudices and afterward take charge of the shop. Let young mechanics and apprentices select the business they intend to follow for life, and, after careful consideration, adopt it with a determination to stick to it. Do not learn a trade or profession simply because some relative or friend wishes you to do so. Many a youth has learned a business after this fashion, started for himself and failed. He blamed the business as the cause of his failure when he alone was to blame, because he had made a wrong choice and was unfitted for the business. He simply tried an experiment to see if he was adapted to the business, and the result proved that he was not. We advise young mechanics to give up the idea that *the world owes them a living*. They indeed have a chance to earn their living, but there is no law which says that the world shall bring the living up to a man's mouth. Another idea that should be given up is that the *old man* (which is a too common and irreverent expression for father), or some other relative, is going to die and leave them a fortune. These ideas are well calculated to occupy the time which a young man should give to study. Another suggestion is that a young man should spend the time out of the shop largely in study, bearing in mind the fact that *a man is always better paid for the labor which embodies thought and mental labor, than for that which merely requires muscular effort.*

Not long since we heard an eminent man in his profession remark: "I expect to buy books, and study as long as I live." We could suggest no better course for adoption by the young mechanic than the above, and if followed up zealously, it will produce pleasant results. Hard work is a pleasure to the youth or young man whose purpose is fixed in regard to his future course, and we hope that our young friends will profit by the practical examples before them, and be encouraged to push forward to the final success, which is sure to crown zealous efforts.

Piece Work on Yearly Contract.

There are many shops in which, undoubtedly, the piece-work system could be adopted to advantage. But there are certain limitations which should also apply in order to give the system its full significance. One of these is that the proprietors extend to contractors and workmen the guaranty against sudden or arbitrary changes in price, that inheres naturally from the existence and strict observance of a written contract for a specified amount of work or length of time. Some shops may wisely choose as long a time as one year.

There are shops making regular lines of work, which are run wholly on the piece-work plan. There are others whose work is partly regular and partly special, or repair work, in which a division is made, part running on the wages system and part on the piece-work plan. There are others which adhere wholly to the wages system. Now, one of the objects of adopting the piece-work system consists in the inducement held out by it for pushing the work along. Another consists in knowing in advance just what the completed work is going to cost. Few shops which have once adopted the piece-work system have ever abandoned it.

But numerous instances have occurred in which the piece-work system has been resorted to, and after prices were fixed considerably lower than the relative cost of the same work under the wages system, new methods and special zeal on the part of contractors and workmen have resulted in so cheapening the cost of the work, that short-sighted proprietors have arbitrarily called contracts off and reduced prices, because the men doing the work were, in their opinion, "making too much money." In such cases, the fact that the proprietors are also making more money than formerly is seldom considered. Instances have occurred in which this demoralizing process has been two or three times repeated.

Now, nobody gains by this sort of thing. In fixing piece-work prices some endeavor should be made to ascertain what is right and fair in the beginning, and contracts should be made covering a proper amount of work or length of time, and the proprietors should set the example of strict adherence to contract. In this way, contractors and workmen have opportunity to improve shop methods and make arrangements calculated to advance their personal interests, with a feeling of safety and certainty. At the end of each contract the making of new contract, on the basis of the results gained from experience under the old, is in order, and fair to both sides; but arbitrary and one-sided changes before that time, are damaging to the true interests of both shop and workmen.

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NEW YORK, MAY 28, 1881.

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The World's Fair Project.

It seems to be generally understood that the World's Fair Commission is moribund, and that the project for holding a great international exhibition in this city in 1883 has fallen through. The alleged reasons for the failure of the present commission have been presented by a large portion of the press, as the lack of interest manifested by the general public in another world's fair, fixed at a time so soon after the Centennial; and, again, as the lack of appreciation of the enterprise on the part of the people of New York City. Those who have carefully watched this movement from its first inception for public consideration, will not require much persuasion to convince them that these reasons are erroneous. When the idea of a world's fair in New York City, to commemorate the hundredth anniversary of the close of the Revolutionary war, was publicly broached, a number of wealthy and public-spirited citizens of this city held an informal meeting, to consider the desirability of holding such a fair. They then organized or appointed a committee, to bring the matter to public attention; and, by suitable inquiry, to ascertain the drift of popular sentiment upon the project. This was known as the "Hilton Committee," and as soon as it got fairly at work, another, and a rival movement began, to hold a world's fair at the same time, and in the same city. The new party got its proceedings extensively noticed by the press; and, by making caustic remarks about the original committee, brought itself into notoriety. After some months of indecorous squabbling, a bill was presented to Congress by the new party, and passed, virtually incorporating the World's Fair Commission, and naming among the commissioners a large portion of those who started the first movement for a world's fair, *without their knowledge or consent*—in fact, without being even asked to serve upon such a commission. Besides this, the name of at least one gentleman was placed in the list of commissioners designated by the bill, greatly to his surprise, who had never taken any part in the world's fair project whatever, and who immediately asked to have his name taken off. The bill was, in short, a stratagem to silence the opposition to the new party, and place the control of the enterprise where it could be used to their advantage. The stratagem did not succeed, and, more than anything else, *is responsible for the failure of the plan* to hold a world's fair in 1883. The members of the original Committee all declined to serve on the Commission thereby created, and after considerable trouble, had their declinations accepted.

Now, after some months of unsuccessful coquetting with railroad and transportation companies to raise money to start the work of preparing for the exhibition, the Commission is debating what it better do next. It can do nothing better than to disband, and allow the original Committee to proceed to get up a world's fair to be held in this city at some acceptable time within the present decade. It has been suggested to hold it in 1887, the one hundredth year from the adoption of the Federal Constitution.

When the people understand that the enterprise is in the hands of those who are capable, and who will push it forward on a fair basis, it will succeed.

Notes of the Mechanical Engineers' Meeting.

Among the many interesting things shown to the members of the A. S. M. E., while inspecting the manufactories of Hartford, were several devices new to some of us. One was the use (at the Hammond Hammer Works) of wrought iron grinding wheels for cutting down and smoothing surfaces of cold steel, working, of course, upon the same principle as the well known metal cutting disc; though whether by the ordinary laws of friction, or by agitating the atmosphere into a fine frenzy, is a question in molecular physics that perhaps we should leave to metallurgical scientists.

In one of the shops visited, where a lathesman was turning up a cone pulley two steps at once, by using two cutting tools properly set, it was remarked by a Western member that no Western machinist could be persuaded to do work in that way. They would not use more than one cutting tool at a time, no matter how much the doubling up would facilitate work.

Mr. A. L. Holley, in relating some experience with peculiarly bright students of engineering, mentioned a case of one whom he had under his instruction, and who secured a position as locomotive engineer. On one wintry occasion, Mr. Holley was traveling on the train run by the erstwhile student, when it became stalled in a snow bank. The boiler got short of water, and as there were no injectors used in those days, it was necessary to haul the fire and let the water out of the boiler to prevent freezing. They remained in that condition until morning, when Mr. H. discovered by the early light the graduate engineer *shoveling snow into the smoke stack to fill the boiler with water.*

Upon visiting one of the factories, attention was attracted to an ingenious method of transmitting 155 H. P. from a new Brown Automatic Cut-off engine to two lines of shafting, by means of a double leather belt, 300 feet long. The two lines of shafting were placed parallel with the engine shaft, and at some distance from the same. Two large pulleys or idlers, were placed upon either side of the fly-wheel of the engine for the purpose of supporting the belt, and obtaining the necessary arc of contact with the wheel.

The belt passed under the fly-wheel, over these two pulleys, and around the two pulleys upon the main lines of shafting. The top part of the belt was prevented from vibrating by passing under an idler.

This transmission worked very nicely, and performed its work in a very satisfactory manner.

Of the complicated and beautiful shapes made by drop forging at the Billings and Spencer Company's and the Weed Sewing Machine Company's, and the marvelously perfect type-setting machine and cigarette machine at the Colt Arms Co.'s there is scarcely room here to speak. The same is true of the beautifully accurate measuring and dividing machines at the Pratt & Whitney Co.'s works.

"Engineering," said Prof. Egleston, of Columbia College, at one of the gatherings of the society, "may be defined as the science of making money for capital. Its two essentials are *honesty of purpose*, and great care to secure *accuracy of results.*

At the Hartford Screw Company, we saw two hundred beautiful automatic screw machines, standing in parallel rows, which were ingeniously set with their axes at an angle of 10° or 12° with the sides of the building, and with the shafting above—the object being to allow the rod of iron being worked into screws, and which projected several feet beyond the end of the machine, to pass *back* of the next machine, and thus save about half the room which would be required if their axes were in line. Of course the belts had a slight twist in them, which had no disadvantage, as the driving pulleys were directly above the driven.

One of the happy thoughts of the social reunion was the following from Mr. James C. Bayles, editor of the *Iron Age*, responding to the sentiment, "The Best of Lubricants—Printer's Ink:"

Printer's ink, considered as a lubricant for what Dr. Holmes has happily called "the racked axle of art's rattling car," is undoubtedly the one which has the least coefficient of friction. It is the best of lubricants for the ways on which great undertakings are launched, and for the grooves along which profitable effort is exerted. What incalculable losses of power does it not avert, and who can estimate the friction which, without it, would wear out our lives in useless work! Civilization would be like Penelope's web, woven by day and ravelled out by night, showing no gain; and the tedious years would come and go empty handed, leaving us still traversing with weary feet the pathways worn by preceding generations.

But it is not only as a lubricant that printers' ink merits the attention of the engineer. We must consider it as a source, as well as a conservator, of power. It has been the pleasure of many writers, and none more gracefully than the late Canon Kingsley, to tell us how the hoarded sunshine locked up in the growing plant uncounted centuries ago, is given forth again as light and heat when the carbon atoms in the coal we throw upon the fire rush to the embrace of the oxygen atoms they parted from when this old world was young. How startling this phenomenon in the case of printers' ink, when its black carbon atoms, warmed to ignition by the divine spark of human intelligence, are mingled with thought, and flash forth from the printed page to illuminate the world and drive the wheels of industry with constantly accelerating speed! There is something more in this than the releasing of the wound spring, or the liberation of the suspended weight; something more than that which we note in the physical phenomenon of combustion—a return of the power in carbon into the forms in which, as light, heat and actinic force, it was absorbed and held by the vegetation of the early world. As letters on the printed page we see the union of carbon with some part of that all-pervading creative intelligence which, as matter, it knew only as a law of nature, and by this union it becomes the true *elixir vitæ* of the alchemist's dream. While we have it truth cannot die nor civilization retrace its steps.

But whether as a lubricant or as a source of power, printers' ink needs to be mixed with brains. It has often been asked, why is it that in a land where inventive genius is a part of our birthright, and mechanical progress springs naturally from the conditions of our rapidly and unevenly developed civilization, we have not long had a great and valuable technical press? Why is it that the literature of the work bench grows, while that of the drafting table has yet to be created? Why is it that the literature of the tap hole and the counting room is profitable, while that of the tunnel head and the laboratory is not? I will tell you. It is one of the elementary truths of mechanics that you cannot get out of one end of a machine more power than you put into it at the other. The work bench and the counting room have put into the mighty engine of the press the power it returns to them. The drafting room and the laboratory have offered the mechanical equivalent of nothing—a glass of water—doubtless expecting that by some trick of the journalist's pen, it would be converted into cold vapor with an irresistible pressure per square inch, and susceptible of infinite verification by the squeak of a goose quill. The expectation has thus far been disappointed; but in the organization of such societies as this, we see the first step in the direction of a great technical press. We may define our objects, draft constitutions, and frame by-laws as we will; but the fact remains that it is only as contributors' clubs, attached to the technical press that such societies as ours can accomplish a work great enough to justify the labor devolving upon the membership. Printers' ink must supply our motive force, and be the lubricant on which we slide into greatness; and if we but mingle with it the best fruits of our study and experiment, it will show us a greater miracle than that which the physicist delights to trace in the formation and combustion of fuel.

The Keely Motor is again attracting some public attention through the dissemination of newspaper accounts of recent exhibitions by Mr. Keely, and occasionally an editorial commending the honesty of purpose of the promoters of the so-called discovery, also advertisements of stock for sale. It was our privilege to be present at one of Mr. Keely's recent evening exhibitions, accompanied by the well-known mechanical engineer, Mr. Charles E. Emery, of this city. From twenty to thirty others were also present, among them several men of public reputation, whose names we have since seen mentioned in print as endorsing Keely's machine as a great invention. Several bullets were fired from a gun by the power from the machine, and the pulley wheel of the "engine" was revolved slowly for about an hour. The engine was in the second story of a small building, and we ventured to ask Mr. Keely for permission to enter and explore the apartment on the first floor directly underneath the "engine." The request was promptly declined, with the excuse that his "vibratory lifter" was in that apartment. In the course of the evening Mr. Emery offered to explain

to those present how the machine was operated, and by what agency, but Mr. Keely *would not permit him to do so.* We have, somehow, lost our interest in the Keely Motor since that exhibition.

One of our correspondents writes:

"I wish, if any of your readers have had any experience in grinding the bearings upon crank pins of steam engines, to make them cylindrical, and were successful; that they would let it be known, and the manner in which it was done."

We would be very glad to hear from any of our readers who have had experience in this line of work.

Literary Notes.

MILLS' DIRECTORY OF BOILER OWNERS AND STEAM USERS for New York and New Jersey. J. N. Mills Publishing Co., 165 Broadway, New York. $5.

Some time since we called attention in these columns to Mills' Directory of Boiler Owners and Engineers for New York City, and still later to his Directory of Boiler Owners and Steam Users of New England. These two works have already had an extensive sale (as they present in convenient form a kind of practical commercial information not elsewhere to be obtained), and we greet this new addition to the commercial literature of steam, not as "filling a want long felt," but as developing at once both the want and the filling. The book gives, in alphabetical order under the designation of each town, small and large, the name, business, location and number of boilers used in each establishment. This gathering of material seems to have been accomplished with commendable thoroughness. Many towns appear in the directory which can boast of no more than a single boiler—perhaps a forge, or a handle works, or a saw-mill, or even a large manufacturing establishment. The book is well printed and bound in cloth, and will prove of no small value to every one furnishing any kind of supplies to steam users. The publishers also announce the early issue of a Directory of this kind for Pennsylvania, Delaware and Maryland.

THE TEETH OF SPUR WHEELS: Their correct formation in theory and practice. By Prof. C. W. MacCord, of the Stevens Institute of Technology.

Our readers will remember the series of three articles, under the above title, which were written for and appeared in the AMERICAN MACHINIST of August 7th, August 14th, and August 21st, 1880. The Pratt & Whitney Co., Hartford, Conn., have republished these articles, together with the engravings, in a neat 52 page pamphlet, with a flexible cloth cover, and are distributing the same *gratis* to those interested in gearing. The subject is divided into three parts, corresponding to the three issues of the AMERICAN MACHINIST, in which it originally appeared as follows: 1st. "General Principles;" 2nd. "Laying out Teeth—The Pitch Circle and Circular Pitch;" 3rd. "The Manufacture of Accurate Gear Cutters."

Questions & Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

(1) T. S, Manayunk, Penn.: Please tell me the dimensions of a bin that will hold one ton of anthracite coal? *A.*—The room required to hold a ton of anthracite coal varies from 32.44 cubic feet up to 41.6 cubic feet according to the kind and quality. You do not state whether you wish a low bin covering, a large area, or a high narrow one in which you may save floor space. We suggest that you decide the floor space to be allowed for the bin, and run it up to a height which will contain the number of cubic feet required to the ton of the kind of coal you intend to use. This information you may obtain by informing us of the floor space you intend to allow, also the kind of anthracite coal intended to be used, or consult almost any of the engineers' pocket books.

(2) S. Z., Hope, Ind., asks: What is the best method of tempering springs for guns and revolvers; also what kind of steel is used? I have lately made the attempt to temper springs made from the tangs of files, but they will not stand. *A.*—Old files as a rule are poor material to make springs, for the reason that the steel is liable to have flaws and may have been overheated. Springs should be made of new steel, and if for fine work it should be of the best quality carefully forged. We have found a charcoal fire the best. The springs when ready for tempering should be heated very uniformly. This may done by placing the springs in a crucible of melted lead covered with fine charcoal to prevent oxidation. Some use a flux for heating springs composed of equal parts of cyanide of potash and salt. After heating, the springs may be dipped in a mixture composed of the following ingredients: 20 gallons spermaceti oil, 20 lbs. beef suet, rendered, 1 gallon neatsfoot oil, 1 lb. pitch and 3 lbs. black resin. The two last ingredients must be melted together and added to the rest. The whole must be heated in a covered iron vessel as it is very inflammable. For drawing the temper the springs may be fried in oil which is better than blazing off, as a more uniform temper is thereby produced. A great deal of practice is required to make a good spring, as the carelessness in performing any one of the many details is fatal to a good result. After the springs are finished and appear to be soft they may be greatly improved by being hammered upon a bright anvil with a bright hammer.

(3) H. S., Allegheny, Penn., asks: Are there any non-conductors of sound? If so please name a few. *A.*—Yes. All substances in which the atoms of which they are composed do not touch each other, or form a broken mass, are non-conductors of sound. A few of such substances are as follows: Cotton, wool, hair, felt, saw dust, feathers, etc.

(4) C. B., South Orange, N. J., asks: 1. Will you inform me how I can blacken brass work upon optical instruments so that it will bear handling without rubbing off? *A.*—Make a strong solution of nitrate of silver in one vessel and of nitrate of copper in another. Mix the two together and plunge in the brass. The brass after being removed from the bath should be heated evenly until the required degree of dead blackness is obtained. This method is of French origin and was kept a secret for years being used for the ornamenting of optical and other scientific instruments. 2. What is the best wood for making patterns for brass castings for the above purposes; also is it necessary to make any allowance for shrinkage in the castings on hollow patterns from one to three inches in diameter? *A.*—Mahogany is probably the best wood for small fine patterns. Metal is still better where it is necessary to produce castings of a uniform size. It is necessary to allow for shrinkage upon all patterns for brass castings, the amount of which depends upon the shape and size of the piece, and for fine work can only be determined by experiment.

(5) S. B., London, Ont., asks something in relation to the fly wheel of a pumping engine which we are unable to understand. If he will put his questions more clearly we will be pleased to aid him in his investigations.

(6) H. S. H., Macon, Ga., asks: Will you give me the best and simplest rule for calculating the horse power of a steam engine? Why is there no universal rule? I think I am correct in believing there is none. If there are several rules, I would like to hear of them. *A.*—All the rules given for working out the horse power of steam engines are only approximations, and there can be no exact rule for that purpose, for the following reasons, viz: When an engine is in perfect order, it will develop the greatest and most economical power possible for that class of engine, but when the engine gets badly worn it may not develop more than one-half its original power, yet, any rule for calculating the horse power would give the same results in both cases. To determine the mean effective or average pressure of steam upon the piston, throughout the stroke, is the only troublesome factor in the problem, and the nearest approximation can only be arrived at by applying the indicator, then measuring the card. In the absence of the indicator, the mean effective pressure upon the piston must be assumed. In some engines the initial pressure, or pressure upon the piston at the commencement of the stroke, is equal to about two-thirds of the boiler pressure, while in the improved automatic cut-off engines, it runs up to within a pound or so of the boiler pressure. From the foregoing you will see why rules will not give accurate results. For rule see bottom of page 3, in the AMERICAN MACHINIST of May 14, 1881. From the results obtained by this rule, deduct about 25 per cent. for friction.

(7) J. L., Grand Crossing, Ill., asks: 1. What is the best composition for the end of valve stems to form the seats for gauge cocks for steam boilers? the valve seats being of brass and the valves drilled out for the reception of the composition. *A.*—Pure lead makes a good valve seat for gauge cocks. The recess in the end of stem should be tinned before the melted lead is poured in, which will firmly unite the lead with the brass stem. Lead melts at temperature of about 600° Fahr., therefore, it is not as likely to melt out as soft solder. The cocks should not be shut so tightly as to squeeze the lead out of the cavity. All that is required is to merely close them so that they will not leak. 2. Is there a cement made which will do for cementing holes in a lead tank used for sulphuric acid bath, that will stand the action of the acid, and also cling to the lead and not wash out? *A.*—There is no cement that we are aware of which will resist the action of sulphuric acid. The best way to stop the hole is to clean the edges and stop it with lead, by the process commonly known as burning. Usually, when lead tanks get so thin as to have many holes, it is cheapest to get new ones. The sheets should be supported by pins not over 12" apart.

(8) T. D. D., Rochester, N. Y., asks: 1. Would you think the plan of casting brass collars on a steel shaft practical for a bicycle hub? The shaft could be from ⅜" to 1¼" diam. I would want the collars about 4" diam. and should finish about 7-16" thick, but should leave quite a large fillet on the inside of each collar. *A.*—The plan would be practical but not likely to prove a first-class job when finished, from the fact that in turning up, the flange would very likely be slipped upon the shaft. A better plan and more satisfactory, would be to turn up the shaft and collar separately, then warm the brass flange and shrink it on. 2. Would you explain how the term alignment, as applied to the erection of steam engines, and also the word plant as applied to the tools in a shop or factory, have come into use. I have been unable to find any such application in Webster. *A.*—The two words mentioned by you are clearly defined in Webster's unabridged dictionary, edition of 1881.

Business Specials.

50 *cts. a line for each insertion under this head.*

Dies, Punches and Special Tools, manufactured by H. H. Coles & Co., 446 N. 12th St., Philadelphia.

To Inventors.--Parties having inventions not patented wishing to sell. Address Lewis F. Brous, 422 Walnut St., Philadelphia.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

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Wood Engravings of Machinery and Tools. Satisfaction guaranteed. Chas. Murray, 58 Ann St., N.Y.

Wanted to arrange with responsible parties for the manufacture of a New Air Compressor. The best yet designed. John Fish, 8 Pine Street, New York.

Special Notice.—Owners and managers of large establishments throughout the country will find information of positive value in our 75 page illustrated pamphlet, entitled "Useful Information for Steam Users." It contains data on the care and management of Steam Engines and Boilers and Rules for Engineers and Firemen. Sent for 25c. in P. O. Stamps. The J. N. Mills Publishing Co., 165 Broadway, New York City.

Special inducements offered to clubs. "Extracts from Chordal's Letters" in book form, now ready. Cloth. 320 pages. Less than 5 copies, $1.50 by mail, each, postpaid. American Machinist Publishing Co., 96 Fulton Street, New York.

James W. See, Designing and Consulting Engineer, Hamilton, Ohio.

J. C. Hoadley, Engineer and Expert, formerly of Lawrence, Mass., has opened an office at 29 High St., cor. Federal, Boston, Mass., where he will be pleased to receive old and new friends.

Manufactures.

A rolling mill is to be built in connection with the Eames Iron Works, Titusville, Pa.

McKee & Fuller, of Fullerton, are building additions to their car works at Allentown.

Jerome Wheelock, Worcester, Mass., is building two pairs of engines, each 24"x48" cylinders, for the new cable system of the Chicago City Railway.

H. S. Manning & Co. received a large order for the tools to supply the new shops of the "United States Electric Lighting Co.," N. Y. City.

Work at the Altoona (Pa.) railroad shops will be brisk this year. Seventy-five locomotives have already been ordered.

Allison & Sons, Philadelphia, the car and tube manufacturers, are erecting another large building adjoining the one put up some months ago.

Munn & Baush will need 30 more men at their Holyoke, Mass., foundry when the addition is finished, making about 60 in all.

Pardee, Snyder & Co., Williamsport, Pa., are enlarging their car and machine works by building additions to foundry, machine shop and wood shops. They employ 175 men.

The Whittier Machine Co., Boston, are building large steam riveting machine for the Hinckley Locomotive Works of that city. It will receive a boiler plate 72 inches wide.

The Pittsburgh, Cincinnati and St. Louis Company has decided to increase largely the capacity of ts shops at Logansport, Ind. The shops at present employ 400 men.

A company has been organized at Muskegon, Mich., for the manufacture of railway cars and locomotives. The contract has been let for the immediate construction of buildings having a frontage of from 500 to 700 feet. The officers of the company are as follows: George C. Kimball, President; Robert Calthness, Vice-President; F. A. Nims, Secretary; Hugh Park, Treasurer.—*Railway Age.*

The Buckeye Works of C. Aultman & Co., employ at present 740 persons, and turn out 30 mowers, 10 harvesters, 6 threshers, 2 Monitor engines, and 6 twine binders per day.

H. S. Manning & Co., 111 Liberty St., have received orders for 475 Freight cars. The cars are being built by Murry, Dougal & Co., Milton, Pa., and J. M. Clark, Howell, Mich.

Latham, Glover & Co., will build a paper machinery manufacturing shop at Windsor Locks, Conn., between the Seymour Paper Mill and the woolen mill

The Corporation of Victoria, B. C., offers a bonus of $5,000, and the Provincial Government $5,000 towards the establishment of a woolen mill at Victoria.

A two-story building, 30x40 feet, is being added to the works of the Morse Bridge Works, Youngstown. The new building will be used as a pattern and templet shop.

Mitchell & Co., manufacturers of hand power, steam and hydraulic hoisting machinery, are about to erect a new factory building on Michigan street, 25x75 feet.—*Chicago Industrial World.*

The Duffy Tool Co., Chicago, are making extensive enlargements to their shops. When these are completed (about July 1st) they will turn out ten tons of steel tools every 24 hours.

The Battle Creek Machinery Co., Battle Creek, Mich., will soon erect a building 40x80 feet to increase their capacity for building wood-working machinery.

Nichols, Shepard & Co., builders of engines and threshing machines, Battle Creek, Mich., have recently erected a new shop 40x100 feet, also an addition to their offices.

Lawrence & Chapin, Kalamazoo (Mich.) Iron Works, are building an addition to their iron foundry. They make harrows, plows, steam engines and other machine work.

By order of the Post Office department at Washington, the name of the post office at Wolcottville, Conn., has been changed to Torrington, and the name of the town has been changed to correspond. Hereafter the manufacturing Wolcottvillians will do business on the Torringtonian plan.

The Indianapolis Car Works Company has purchased grounds and made contracts for the completion of works by July 1, when it expects to have 400 men employed. Riley McKeen is president, and Charles Milliard, of Terre Haute, general superintendent.

A new brass foundry with a cupola for gray iron castings is to be started in the village of Shelton, near Naugatuck. The buildings are being erected, consisting of a foundry 60x35 feet and a building for pattern shop, offices and other purposes 25x25 feet. H. S. DeForest is the proprietor, and he intends to do as good work as is done in the Naugatuck Valley, or elsewhere.—*Boston Journal of Commerce.*

Wages have advanced, not only for free labor, but also for convict labor. The boom has struck the state prisons. The contract for the labor of 200 convicts, in the Massachusetts state prison at 60 cents per day per man has been let to Blanchard, Fuller & Co, boot and shoemakers, and of 20 men at the same price to Eastman, Hunting & Carter, brush makers, an advance of 10 per cent on former rates.

A steam cylinder, said to be the largest ever made, was cast, recently, at the Morgan Iron Works, New York. It required 90,000 pounds of molten gun metal to fill the mould. The cylinder is intended for a new steamship of the Old Dominion steamboat company. The two main shafts of the same vessel will weigh, when forged, 85,000 pounds each, and are said to be the largest forgings hitherto made in this country.

The Attleboro' Machine Company of Attleboro', which has been established four years, has just leased a new shop, especially fitted up for them, with all modern facilities and improvements. The shop is 60 by 40 feet, two stories high and is operated by steam power. They will continue to make a specialty of jewelers tools, of which they keep a full line on hand, and improved fire hydrants. They now employ twenty hands, but will soon increase this number.—*Boston Commercial Bulletin.*

The Billings and Spencer Co., Hartford, have nineteen drop hammers constantly running on drop forgings; also two or three tilt hammers making forgings, yet are unable to keep up with their orders. A week ago they received an order for ten thousand sewing machine shuttles from Birmingham, England. An extraordinary demand now exists for Billings' Pocket Wrench and for their ratchet drills and lathe dogs.

The U. S, Circuit Court has just decided the case of the Consolidated Safety Valve Co., of Boston, against E. B. Kunkle, of Ft. Wayne, Ind., in favor of the plaintiff. The action was for infringement of the patent of the Richardson Safety valve owned by the above company. The court held that the valve made by Kunkle depended for its operation to some extent, if not wholly, upon the principles used in the Richardson valve. The court said that in administering the patent law, the most dangerous pirating upon well-established patents were those that simply approximated to the results by falling a little short in some of the elemental parts and yet, come near enough to produce the result the patentee intended. In conclusion the Court held that the Kunkle valve was an infringement of the valve owned by the Consolidated Safety-valve Company, and gave Kunkle the privilege of giving a bond to answer whatever damages might be adjudged on final hearing of the case, or in default of such bond a preliminary injunction should issue restraining the further infringement of the Richardson patent.

Machinists' and Engineers' Supplies.

New York, May 12, 1881.

Some houses report a very active business, and others a slacking up on orders. All agree that standard supplies, both for machinists and engineers, are scarce. Some complain that they cannot get their orders filled sooner than six months from the date of placing them. In the decease of J. M. Montgomery (on the 9th inst.), who has for some years conducted a machinists' supply store at 105 Fulton Street, New York, the trade will lose a prominent and esteemed member. Arrangements will be made to continue the business at the same place. A new steel pocket-thread-gauge tool has just been placed upon the market. It has gauges (shutting in like the blades of a knife) to fit all even threads from 10 up to 40 per inch. O. L. Packard, Milwaukee, Wis., has just issued a new illustrated catalogue of "machinists', engineers' and amateurs' hand tools," which will be mailed upon application. The Lehigh Valley Emery Wheel Co. write us that the name of the town, where their factory is located, has been changed from Weissport (Penn.) to Lehighton. This will give printers some extra jobs in printing new letter heads for the business concerns in that town.

Iron and Metal Review.

New York, May 12, 1881.

Dullness is still the prevalent symptom in Pig Iron. Foundries are full of work, but won't buy iron beyond immediate requirements. We quote No. 1 Foundry, $24 to $25; No. 2, $22; Grey Forge, $20; Coltness, $23.50 to $24; Glengarnock, $22.50; Eglinton, $21.50, and Gartscherre, $22.50 to $23. Manufactured Iron from store remains on a basis of 2.5c. for refined. In boiler makers' supplies there has been no unusual activity. We quote: Tank, 2¾c. to 2¾c.; Refined, 3c. to 3¼c.; Shell, 3¼c. to 3¾c.; Flange, 4¼c.; Extra Flange, 5¼c. to 5¾c.

In Metals there has been nothing beyond the usual business done. Lake Copper sells in small lots at 19c. to 19¼c.; Tin is rather quiet, at 20c. to 20¼c. for Straits and common English in jobbing lots; Pig Lead is somewhat stronger—common selling at 4¾c. to 4¾c.; Refined Lead is without business; Domestic Spelter sells at 4⅞c. to 5⅛c., and Silesian at 5⅜c.; Sheet Zinc rules at 7c.; Antimony is held at 14½c. to 15c.

WANTED

The advertiser wishes the assistance of some reliable business party of means, in taking out British patents for an invention of undoubted value for steam engines. None but responsible parties need address. F. B. Rice, Dunkirk, N. Y.

Wanted.—Foreman for machine shop doing a general business. He must be an energetic and thorough mechanic. Eagle Iron Works, Des Moines, Iowa.

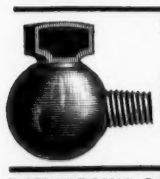
Wanted.—Situation as draughtsman and foreman in Railroad shop. Thoroughly acquainted with the ordinary eight wheel, Mogul and Consolidated types of engines. Also car work. Filling a similar position at present. Reference present employers. Sutherland, care American Machinist Office.

First class machinist, understanding printing press machinery and capable of superintending a shop, may address, with references, Manufacturer, care, American Machinist, New York.

Wanted 2 or 3 young, active, and strictly first class Pattern Makers, best wages paid and steady work all summer. Queen City Pattern Works, Alex. D. Cunny, 204 E. Front St., Cincinnati, Ohio.

A first-class designer and draughtsman on watch, gun and sewing machine, special tools, and machinery, desires a situation. Practical at bench lathe &c. Address, A. B., American Machinist, 96 Fulton St.

Wanted—A Draughtsman familiar with general Machine and Tool work of the best class. Must have sufficient practical experience to properly work up designs, and proportion details. Address, giving complete particulars as to experience, wages expected, reference, etc. Address, Machinery Company, care American Machinist, 96 Fulton St., N Y.



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Manufacturers of Emery and Corundum Wheels and Grinding Machinery.
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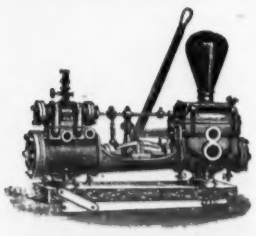

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36 in. Swing, 12 ft. 10 in. bed. Weight, 10,000 lbs. Latest design, extra heavy, workmanship guaranteed first-class.
OHL & CO., East Newark, N. J.

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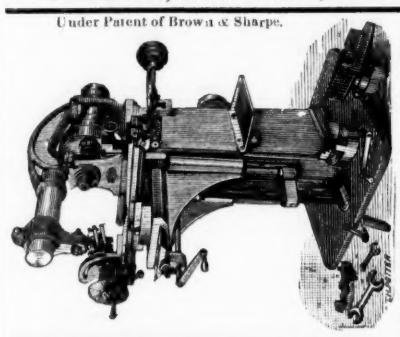
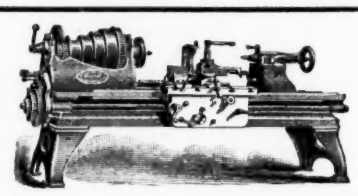


Universal Milling Machine, Manufactured by A. Alex Pool & Co., Newark, N. J., U. S. A.



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Of every description,
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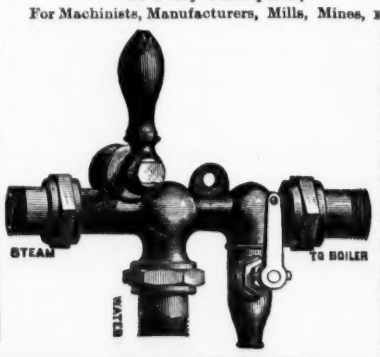

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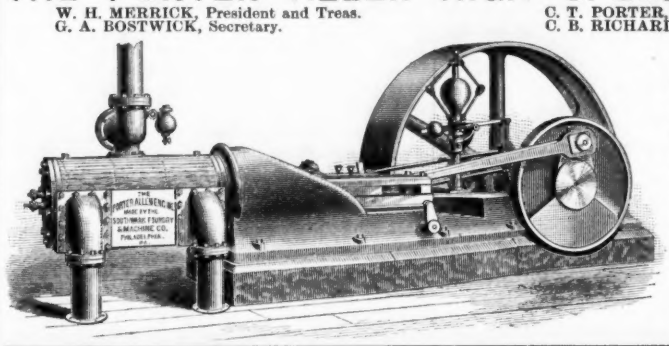
G. A. BOSTWICK, Secretary. C. B. RICHARDS, Superintendent.



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Designed for use in Gold, Silver, Coal and Iron Mines. Also for general Manufacturing and Fire purposes.
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THE A. S. CAMERON STEAM PUMP WORKS,
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KEARNEY & FOOT
Office, 101 Chambers Street, N. Y. — **Full Weight Hand-Cut Files.** — Manufactory, PATERSON, N. J.
The best and cheapest in the end. Send for quotations. The files speak for themselves in the following testimonials. Read them.
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Dear Sirs:—We have for the past ten years used the Files of your manufacture, and during that time we have never had any fault to find with them. We can safely affirm that for evenness of temper, sharpness of cut, accuracy of shape and all other qualities which go to make up a perfect File, they are equal, and in some respects superior, to the best English-made Files. Very Truly, Wm. H. INSLEE, Contractor.
Messrs. Kearney & Foot, Elizabethport, N. J., May 3rd, 1877.
Gentlemen:—We have been using your Files, both new and re-cut, for several years, and take pleasure in saying that we have found them a very superior article.
HANS REISE, Contractor, with The Singer M'f'g Co.
We print on card board 10 x 12 in. "Instructions on the use of Files," which are intended for shop use. These instructions with our "Illustrated Catalogue of Files" we mail on receipt of 27 cents postage. To customers we mail a complete set free of charge. KEARNEY & FOOT.

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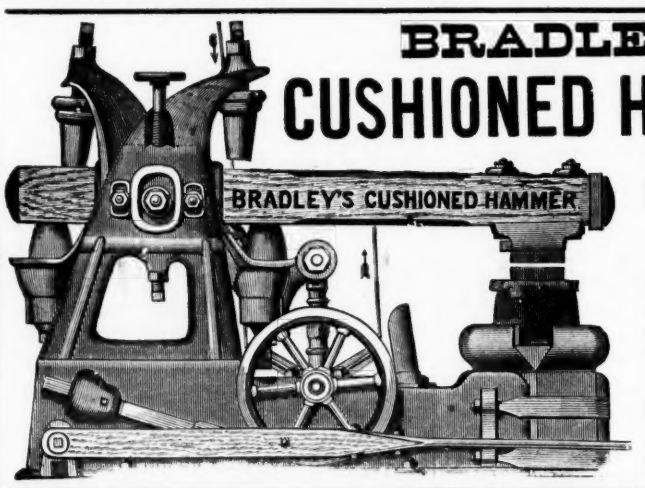

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It approaches nearer the action of the smith's arm than any hammer in the world.
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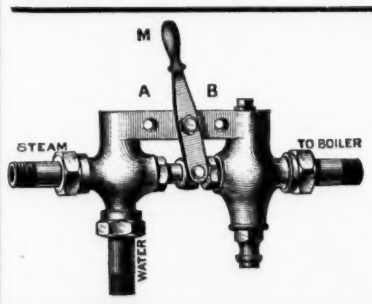

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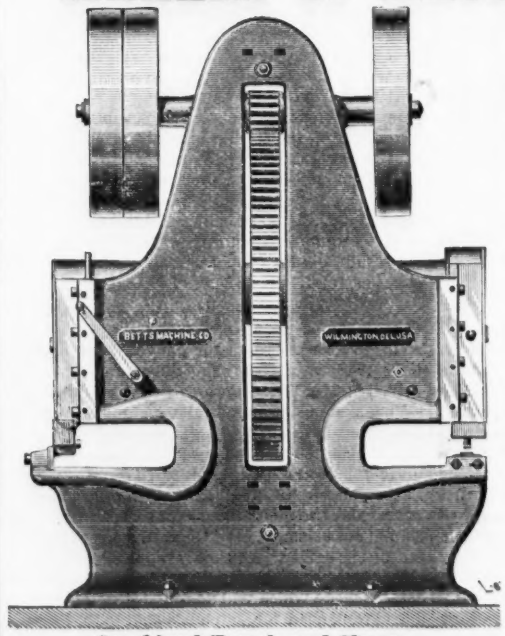

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